INVENTING TOMORROW

POWER PLAYERS

When it comes to business, Institute of Technology grads have the right stuff >>

INVENTING TOMORROW

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Inventing Tomorrow welcomes readers' comments about the magazine and story ideas for future issues. We're looking for students, faculty, and alumni involved in interesting projects or conducting breakthrough research. Email your comments and ideas to us at inventingtomorrow@it.umn.edu.

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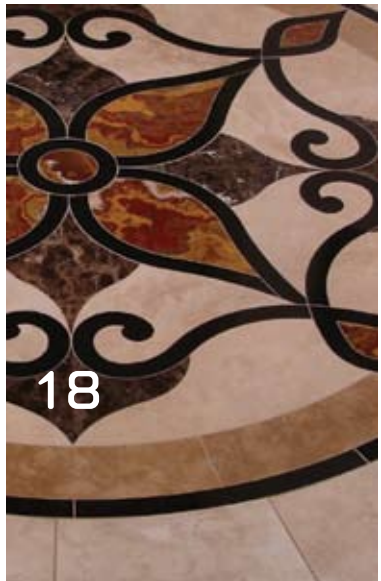

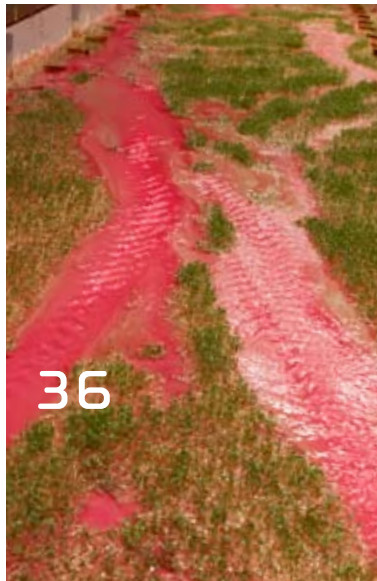

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PHOTO BY JONATHAN CHAPMAN

Past success paints picture for the future

I believe the Institute of Technology is one of the University's greatest assets, especially at this critical juncture in its history

THE BEGINNING OF A NEW CALENDAR YEAR is a natural time for contemplating the past, celebrating the present, and planning for the future. During 2005—my first year as dean of the Institute of Technology—I talked with hundreds of people about how the college can best serve the University and our citizens during a time of transformational change.

As many of you know, the University of Minnesota has set the ambitious goal of becoming one of the world's top three public research universities within the next 10 years. We are in the early stages of this systemwide strategic positioning initiative, with 34 task forces currently gathering information and making preliminary recommendations to top University leaders.

In this issue of *Inventing Tomorrow* you will find evidence to support my contention that the Institute of Technology is one of the University's greatest assets, especially at this critical juncture in its history. The college's strengths—in research, academics, interdisciplinary collaborations, external partnerships, and human resources—place us in an ideal position from which to serve the University's goal and advance the public good.

Many of our alumni reflect the University's past success in their accomplishments today. In "Power Players" we tell the stories of eight Institute of Technology alumni who achieved their goals by thinking big, taking risks, working hard, and solving problems creatively.

The legacy of the past and its impact on the present are also illustrated in "Retrospect." The article traces the lineage of transportation safety research at the University, from the hands-on experiments by the legendary James "Crash" Ryan during the 1950s to the high-tech, interdisciplinary work now under way at the Center for Transportation Studies.

Today, more than ever before, people expect their public research universities to deliver breakthrough solutions in the sciences and technology. In this issue you will meet some of the college's researchers who are working to meet those expectations.

One article showcases the important research by chemistry professor Thomas Hoye, who is involved in developing a nontoxic synthetic pheromone to control the sea lamprey population in the Great Lakes. Another article highlights recent support from the National Science Foundation for groundbreaking research at the University's Institute for Mathematics and its Applications. You'll also learn about the researchers who are working to understand and predict the dynamic forces of nature in an effort to minimize the impact of natural disasters.

Serving the public good also means that we must do all we can to encourage and prepare more students at all educational levels to pursue careers in science and engineering. A recent grant from the 3M Foundation is helping us launch several outreach programs this year to increase the number and diversity of engineering students in the future. In addition, a gift from Boston Scientific is establishing a fellowship fund in biomedical engineering that will allow us to continue to attract top graduate students.

For those of us in the Institute of Technology, complacency is not an option—especially at a time when the future of our University, the state, and the nation is at stake. As dean, I am committed to using the college's resources in ways that best serve our students, faculty, stakeholders, and the larger community. Your ideas and suggestions will help guide our decisions during this pivotal time.

I care very deeply about this college, which has been part of my life for more than 40 years. With your help, I will do everything I can to ensure its bright future. ■

U figures in top tech-city ranking for Minneapolis

THE UNIVERSITY'S Digital Technology Center (DTC), Center for Distributed Robotics, and Laboratory for Computational Science and Engineering are three reasons why Minneapolis ranks as America's top tech city, according to a recent article in *Popular Science*. The centers and lab are part of the Institute of Technology.

The survey placed Minneapolis first among U.S. cities in innovative transportation solutions, fourth in energy technology, and above the 50th percentile in every category measured. Calling the University "home to quite a roster of innovative thinkers" and an "invention factory," the article describes the synergy created by the DTC's interdisciplinary research and partnerships between the University and industry, all of which typify the city's creative mindset.

In a related story, the St. Paul *Pioneer Press* reported that two companies, Aveso and InnovaLight, were originally attracted to Minnesota by nanotechnology research and expertise within the Institute of Technology. Aveso, a spinoff from Dow Chemical, produces ultra-thin low-power printed electronic displays. InnovaLight is developing a nanotech approach to making lightbulbs.

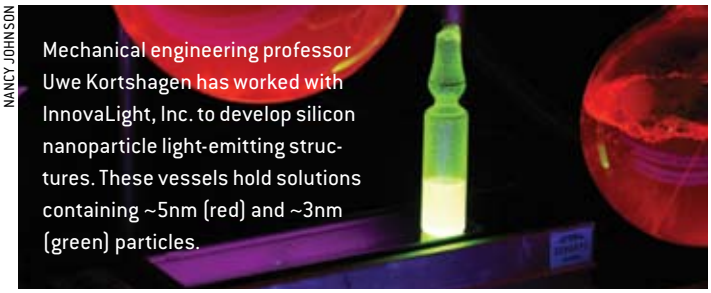
DIGITAL TECHNOLOGY CENTER

Computer science and engineering graduate student Brian Ries (left) and Birali Runesha, a group manager at the Minnesota Supercomputing Institute, test the virtual-reality window at the Digital Technology Center. The equipment allows users to walk through a site simulation and see the impact of design modifications on the environment.

The DTC, guided by director Andrew Odlyzko, received high marks from *Popular Science* for its focus on interdisciplinary research, numerous partnerships between the University and industry, and programs that give students what they need to succeed in today's digital society.

The Center for Distributed Robotics team, led by computer science and engineering professor Nikolaos Papanikolopoulos, was recognized for its development of Scout robots—soda-can-sized search-and-surveillance robots that could be used to find victims buried in a collapsed building or kidnappers hiding in a house. The article also mentions another of the center's projects—the design of a smart video-monitoring system to detect unattended packages in public spaces and other suspicious situations. Being developed with funding from the U.S. Department of Homeland Security, the system will get a test at the Omaha airport, said Professor Maria Gini, another robotics expert and colleague of Papanikolopoulos.

Popular Science also mentioned Paul Woodward, professor of astronomy and director of the University's Laboratory for Computational Science and Engineering, who demonstrated his minutely detailed 3-D simulations of the internal workings of stars.



NANCY JOHNSON

Mechanical engineering professor Uwe Kortshagen has worked with InnovaLight, Inc. to develop silicon nanoparticle light-emitting structures. These vessels hold solutions containing ~5nm (red) and ~3nm (green) particles.

U ranks high in nanoscience

THE UNIVERSITY OF MINNESOTA was recently ranked as one of the top five U.S. universities in nanoscience research and industry outreach programs in nanotechnology, according to the results of a survey conducted by *Small Times* magazine. Sent to more than 100 universities in the U.S., the survey measured respondents' research, educational opportunities, resources, commercialization, and outreach programs in microtechnology and nanotechnology.

Mathematics institute receives $19.5 million NSF grant

THE INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS (IMA) recently received a grant of $19.5 million over five years, the largest single math research grant ever made by the National Science Foundation (NSF). The IMA, a research center within the Institute of Technology, is now the nation's top math institute in terms of funding.

Founded in 1982, the IMA brings together mathematicians and experts in a wide range of disciplines to solve important scientific, technological, and social problems. With no permanent faculty, the IMA involves more than 1,000 people each year who focus on a thematic program selected by a national board.

"The IMA has become a preeminent mathematics institute that serves as a model for other institutes worldwide," said William Rundell, director of mathematical sciences at the NSF. "Its innovative interdisciplinary programs are an essential component of the NSF's portfolio."

During the 2005–06 academic year, the IMA is focusing on imaging—any of the ways to visualize data from the real world, such as a magnetic resonance imaging (MRI) scan—and then exploring how to get information from that data.

"Basically, what we do with a program like this is to make the IMA the most exciting department focused on imaging in the world for that 10-month period," said Doug Arnold, the institute's director.

The IMA has hired eight postdoctoral fellows and three industrial postdoctoral fellows who are in residence at the University to participate in the imaging program and conduct research. The IMA also scoured the globe to bring many of the world's leading imaging experts to the University for long-term visits during the program. As it has in the past, the IMA assembled a highly interdisciplinary group including mathematicians, physicists, engineers, computer scientists, and medical researchers. Applications being studied by researchers at the IMA range from medical to military, from petroleum reservoirs to distant galaxies.

Weeklong workshops and public lectures are also being conducted on specific issues pertaining to imaging.

The IMA helps forge links where none were seen before as it solves problems with broad social implications. For example, the language of computer security is highly biological—systems are "infected" with viruses and worms—and computer scientists look to biological systems for inspiration to combat such attacks. In turn, biologists can learn about the immune system by studying engineered systems, like computer networks.

A few years ago, immunologists, mathematicians, and computer scientists came together at the IMA to explore the issue and discovered a breakthrough for computer security systems. They changed their approach from one of destroying a virus or worm to adapting the computer system to survive a hostile invasion—just as the human body's immune system springs to action when it detects an infection.

"We've set an ambitious goal for the University of Minnesota to be one of the top three public research universities in the world. Accomplishments such as this move us closer to achieving that goal," said University President Robert Bruininks.

Visit www.ima.umn.edu to find out more about the IMA.

TREVRE ANDREWS

A team of 45 students from eight majors dedicated more than 43,000 hours over a 19-month period to research, design, and fabricate the University's Borealis III solar car.

A RACE TO REMEMBER

AFTER 11 DAYS and more than 54 hours of racing across the United States and Canada, the University of Minnesota's Borealis III solar car finished second by only 11 minutes to the University of Michigan's car in the 2005 North American Solar Challenge. It was the second straight runner-up finish for the University in the 2,500-mile biennial race for solar-powered vehicles.

Twenty teams competed in the race, which began July 17 in Austin, Texas, and ended July 27 in Calgary, Alberta, Canada.

Throughout the event, the lead changed hands on several occasions, with the Minnesota, Michigan, Massachusetts Institute of Technology, and the University of Missouri-Rolla teams all in first place for portions of the race. However, Borealis III and Michigan's car, Momentum, were the primary leaders.

A team of 45 University undergraduate students from eight majors dedicated more than 43,000 hours of extracurricular time to research, design, and fabricate Borealis III over a period of 19 months. Nineteen students were involved with the race as part of the road team. Professor Patrick J. Starr (mechanical engineering) served as advisor to the group.

"We're really proud," said student Trevre Andrews, the University's solar car project manager, after the race. "We couldn't have done anything more, other than catch a few [more green lights]."

Prior to the North American Solar Challenge, the car finished in first place at the three-day Formula Sun event in Kansas.

Dean promotes the college during China visit

STEVEN CROUCH, Institute of Technology dean, was one of 200 delegates who visited China this past fall as part of the new Minnesota-China Partnership, a broad-based initiative to strengthen the state's long-standing ties with that country.

The mission featured events in Beijing, Shanghai, and Hong Kong. While in Beijing, the dean gave a presentation to the Chinese Academy of Sciences about possible collaborations in research.

The University of Minnesota currently has more than 1,200 visiting Chinese scholars and students, the largest population on a North American campus.

FACULTY AWARDS

Professors **E. Calvin Alexander** and **Chris Paola** (geology and geophysics) are among 16 individuals recently inducted into the University's Academy of Distinguished Teachers.

Distinguished McKnight University Professor **George Barany** (chemistry) received the Ralph F. Hirschmann Award in Peptide Chemistry from the American Chemical Society for creating pioneering methods of synthesizing peptides.

Distinguished McKnight University Professor **Frank Bates** (chemical engineering and materials science) has been awarded the distinction of Fellow by the American Association for the Advancement of Science (AAAS). The AAAS recognized Bates for outstanding contributions to the development of new polymeric materials.

Professor **Edward Cussler** (chemical engineering and materials science) received the 2005 Fred Merryfield Design Award from the American Society for Engineering Education, which recognizes excellence in teaching engineering design.

Shimuzu Professor **Andrew Drescher** (civil engineering) was awarded the 2005 Distinguished Engineer of the Year Award from the Minnesota Federation of Engineering, Science, and Technology Societies.

Professor **Georgios Giannakis** (electrical and computer engineering) received the 2005 Technical Achievement Award from the European Association for Signal, Speech and Image Processing, the association's highest award given to an individual.

Professor **Steven Girshick** (mechanical engineering) received the 2005 Plasma Chemistry Award from the International Plasma Chemistry Society. The award is given every two years to an individual who has made significant, longtime research contributions to plasma chemistry and plasma processing.

Professor **John Gulliver** (civil engineering) was one of five University faculty and staff members to receive Fulbright Scholar Grants for special research projects in 2005–06. Gulliver was at the University of Chile in Santiago from July to December 2005. He studied and gave lectures on flow and chemical transport in environmental systems.

Associate Professor **Ramesh Harjani** (electrical and computer engineering) has been elected a Fellow of the Institute of Electrical and Electronics Engineers for his contributions to the design and computer-aided design of analog and radio frequency circuits.

Assistant Professor **Christy Haynes** (chemistry) received the 2005 American Chemical Society Nobel Laureate Signature Award for Graduate Education in Chemistry for her doctoral thesis, which was completed in 2003.

Professor **Joachim Heberlein** (mechanical engineering) received the American Society for Metals–Thermal Spray Society Award for Outstanding Leadership and Service as chairman of the *Journal of Thermal Spray Technology*.

Professor **Wei-Shou Hu** (chemical engineering and materials science) won the 2005 Marvin J. Johnson Award in Microbial and Biochemical Technology for his work in animal-cell biotechnology, liver tissue engineering, and metabolic engineering for antibiotic production.

Professor **Frank Kulacki** (mechanical engineering) received the Distinguished Service Award from the American Society of Mechanical Engineers.

Professor **Vipin Kumar** (computer science and engineering) has been selected as a Fellow of the Association for Computing Machinery, an international professional organization dedicated to the advancement of computer science.

Assistant Professor **Jennifer Maynard** (chemical engineering and materials science) was awarded a 2005 Packard Fellowship in Science and Engineering. She received the fellowship for her work on re-engineering a system that recognizes specific cell types, which will impact the design of therapeutic proteins as well as fundamental cell biology and virology studies.

Professor **Mikhail Shifman** (physics) has been chosen to receive the 2006 Julius Edgar Lilienfeld Prize from the American Physical Society. Shifman, who holds the Ida Cohen Fine Chair in Theoretical Physics, was recognized "for his contributions to theoretical high energy physics, in particular for the understanding of strong interactions and dynamics of supersymmetric gauge theories and for communicating the excitement of science to the public."

Professor **Donald Truhlar** (chemistry) received the Peter Debye Award in Physical Chemistry from the American Chemical Society for his work in developing methods for computing the rates at which chemical reactions occur.

Professor **Michael Tsapatsis** (chemical engineering and materials science) is the recipient of the 2005 Stratis V. Sotirchos Lectureship from the Institute of Chemical Engineering and High Temperature Chemical Processes.

Professor **Arkady Vainshtein** (physics) received the 2005 Pomeranchuk Prize from the A.I. Alikhanov Institute for Theoretical and Experimental Physics, in Moscow, Russia. Vainshtein shares the prize with his collaborator, Iosif Khriplovich of the Budker Institute of Nuclear Physics in Novosibirsk, Russia. They were honored for outstanding contributions to the understanding of the properties of the standard model, especially for illuminating work on weak and strong interaction of quarks.

Professor **Bruce Wollenberg** (electrical and computer engineering) was formally inducted into the National Academy of Engineering at a ceremony held in November 2005 in Washington, D.C. Wollenberg was honored for his contributions to control centers for electric power grids and his contributions to power engineering education.

The nose knows

University researchers work to eliminate scourge of the Great Lakes

THE SEA LAMPREY has been around for 400 million years, so it's a safe bet the parasitic eel-like fish comes equipped with top-of-the-line survival tools. But the scourge of the Great Lakes may finally have met its match.

Chemistry professor Thomas Hoye and several graduate students in his lab are members of a University research team intent on converting one of the lamprey's most powerful assets into a liability. They are collaborating with a group led by Peter Sorensen, a professor in the Department of Fisheries, Wildlife, and Conservation Biology, to develop a species-specific, nontoxic synthetic chemical attractant (pheromone) as a means of controlling the sea lamprey population.

An ocean native, the lamprey invaded the Great Lakes early in the 20th century and soon decimated stocks of lake trout, whitefish, chub, and other commercially valuable species. Although it spends only about a year of its life as an adult parasite, each lamprey kills on average 40 pounds of fish, according to the Great Lakes Fishery Commission, which is responsible for sea lamprey control. Last year alone, the U.S. and Canada spent more than $16 million on lamprey control, primarily through the use of lampricides that kill the larvae but also some innocent species.

> "Personally, the most rewarding part of this work has been to watch my students grow and develop into really skilled chemists."

As adult lampreys near the end of their lives, they have only a few weeks in which to migrate from their normal habitat in lakes or coastal waters to freshwater streams where they spawn. However, only about one in 10 freshwater streams provides a suitable spawning ground and nursery habitat for larval lampreys, which spend three to 20 years burrowed into the streambed. Adults locate these streams by following the scent of a powerful pheromone emitted by the toothless, blind larvae.

The pheromone works so well that simply using extracts of water from larval lamprey nurseries improved adult attraction rates sixfold during experiments in Michigan streams. However, the protocols for isolating even the crude pheromone from huge volumes of stream water are so cumbersome that this approach is unlikely to support the needs of a large-scale, pheromone-based control program. Given the extract's potency, the scientists reasoned, a synthetic version of the pure pheromone would be even more effective in luring migrating lampreys to traps where they could be sterilized, killed, or moved to streams unsuitable for spawning.

Sorensen spent more than a decade testing the hypothesis that a pheromonal cue guided migratory adult lampreys to spawning sites. Using mass spectrometry his team had detected the pheromone's three primary components, two of which were unknown. The next step was to isolate samples of each of the pheromone's chemical components for analysis.

That's when Hoye and his team joined the study. About four years ago Jared Fine, then a beginning graduate researcher in Sorensen's group, sought Hoye's expertise in nuclear magnetic resonance (NMR) spectroscopy, a nondestructive analytical tool for determining precise chemical structure.

After purifying 8,000 liters of water from holding tanks containing 35,000 larvae, Fine obtained only 600 to 700 micrograms of a fine white powder—the equivalent of about 10 grains of salt. But it was enough.

"NMR spectroscopy is a sufficiently sensitive technique, so you need only a tiny amount," said Hoye. "And it's nondestructive, which means that after we had finished our analysis I could return the samples to Jared intact for subsequent biological studies."

Matching the NMR data to known spectral patterns, Hoye and students Vadims Dvornikovs, Christopher Jeffrey, and Jizhou Wang identified the two components and pieced together their molecular structure. They discovered that the most abundant pheromonal component, petromyzonamine disulfate (PADS), has a structure similar to that of squalamine, a chemical produced by the dogfish shark. Using that information as a resource, Dvornikovs and Jeffrey, together with students Feng Shao and Kari Anderson, produced a small amount of synthetic PADS—about six milligrams to date. This initial synthesis required a linear sequence of nine chemical reactions and took nearly a year to develop.

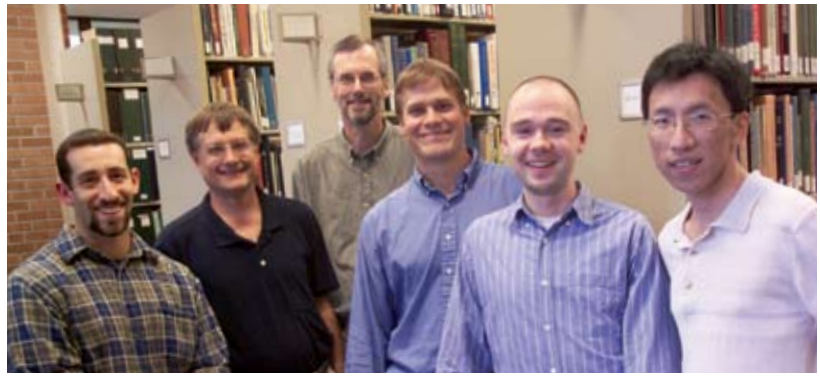


PHOTO COURTESY THOMAS HOYE

An interdisciplinary research team intends to hoodwink the lamprey's keen sense of smell. Collaborators include (from left) Jared Fine, Professor Peter Sorensen, Professor Thomas Hoye, Christopher Jeffrey, Vadims Dvornikovs, and Feng Shao.

PHOTO COURTESY THOMAS HOYE

With a face only a mother (or a chemist) could love and a repellent eel-like body, the sea lamprey hasn't much going for it in the looks department. But when it comes to sexual chemistry, the sea lamprey is a powerful player in the game of survival. Chemistry professor Thomas Hoye is among the researchers who are creating a synthetic version of the pheromone that attracts the parasitic species to its spawning grounds. The faux pheromone would be used to lure migrating lampreys to traps.

To hoodwink the sea lamprey's keen sense of smell, a synthetic compound must replicate the natural pheromone precisely. Of the chemical produced in his lab Hoye said, "It is exactly the same in every way. Not even the animal can distinguish it from nature's version."

PADS is extremely potent. A pound of it (about 500 grams) could treat the volume of water that spills over Niagara Falls in a month—at the rate of 100,000 cubic feet of water per second. However, laboratory tests suggest that the pheromone may function even more effectively as a mixture. Even at elevated concentrations, a single component generated less lamprey activity than the larval water extract.

In November 2004 Hoye and Sorensen filed a patent application on PADS. The researchers' findings mark the discovery of the first migratory pheromone identified in a fish.

Currently, Hoye is conducting studies to synthesize the second major component, petromyzosterol disulfate. The next challenge will be to refine the synthesis of the pheromone so that large-scale production is affordable. Hoye expects that process to take between two and three years.

"Personally, the most rewarding part of this work has been to watch my students grow and develop into really skilled chemists in a context that likely will have a direct benefit," Hoye said. "It's great to have a hand in something that may actually get used."

The research was supported by the University's Agricultural Experiment Station, the National Institutes of Health, and the Great Lakes Fishery Commission. ■ CAROLYN WAVRIN

FOR MORE INFORMATION see www.chem.umn.edu/groups/hoye

PROFESSOR WRITES NEW BOOK ON PHYSICS OF SUPERHEROES

ANYONE WHO HAS TAKEN Professor James Kakalios' freshman seminar knows that he's adept at breaking the fear-of-science barrier.

He taught Newton's famous equation *F=ma* not as a dry explanation of how a force imparts acceleration to a mass but as the inescapable principle behind the death of Spider-Man's girlfriend, Gwen Stacy (in the comic book, not the movies). His seminar, "Everything I Know About Science I Learned From Reading Comic Books," was a hit, and with the 2002 release of the first Spider-Man movie, Kakalios' class made him an instant celebrity of sorts.

Now, everybody can get the benefit of Kakalios' wit and wisdom. He has put his ideas into a new book, *The Physics of Superheroes*, which is illustrated with panels from famous comic books featuring Superman, The Flash, The Atom, and, of course, Spider-Man.

If you somehow missed the rash of news reports of Kakalios' seminar three years ago, you're probably wondering what happened to Gwen Stacy and what Isaac Newton had to do with her. When the Green Goblin pushes Gwen off the George Washington Bridge, Spider-Man quickly casts out his web and stops her fall. But when he hauls her up, he discovers she is dead. Kakalios blames her demise on Spidey himself.

"Assuming that Spidey's webbing catches her after she has fallen approximately 300 feet, Gwen's velocity turns out to be nearly 95 mph," he explained. Using Newton's second law of motion, Kakalios shows how Spidey's web would have slowed her down almost instantaneously, exerting a force strong enough to snap her neck.

In the chapter titled "Me Am Bizarro! Superhero Bloopers," Kakalios' book provides many funny examples of physics errors in comic books. If the laws of physics applied, Spider-Man foe Doctor Octopus would be a comically inept villain with a tendency to tip over whenever he raised and moved the heavy robotic arms fused to his body.

Another glaring error is a comic book panel depicting an early stage in the career of The Atom that implies "in the mid-1960s, physics professors typically drove Cadillac convertibles." Kakalios certainly doesn't need any formulas to know that isn't true.

JONATHAN CHAPMAN

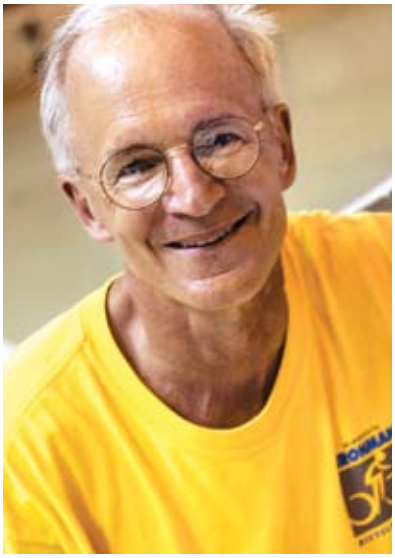
Professor James Kakalios makes physics fun in his new book *The Physics of Superheroes*, which features illustrations from famous comic books.

Taking the plunge for science nets researchers unique award

EXCEPT IN YOUR MOST NIGHTMARISH dreams, you will never find yourself swimming in a slimy, greenish swamp or in a sticky pool of maple syrup. But if you did, your top speed would likely be close to whatever you can clock in a regular swimming pool.

That little nugget comes from an experiment by chemical engineering and materials science professor Ed Cussler and his former student Brian Gettelfinger (ChemE '04). In August 2003 they filled a Cooke Hall pool with a syrupy concoction and timed male and female University swimmers to find out how a gooey medium would affect swimming speeds. In a ceremony at Harvard University last fall, the two received an Ig Nobel Prize for their efforts, joining the immortal ranks of scientists whose work tickles the funny bone en route to making a serious scientific point.

Awarded at the same time and generally in the same fields as the real Nobel Prize, the "Igs" celebrate research that both amuses and enlightens. The tongue-in-cheek Ig awards ceremony is staged annually by the *Annals of Improbable Research*, a publication dedicated to scientific humor.



JONATHAN CHAPMAN

Professor Ed Cussler recently accepted an Ig Nobel Prize for his experiment that tested swimmers' speeds in a gooey medium. The tongue-in-cheek Ig awards celebrate research that both amuses and enlightens.

In designing their experiment, Cussler and Gettelfinger asked whether swimmers would be slowed by a gooier medium or whether such a medium would give swimmers something more solid to push against, thereby imparting more thrust. After securing necessary permissions and recruiting University swimmers to be volunteer test subjects, the researchers filled the pool with guar gum, a food-thickening agent. Then Cussler, an avid runner, swimmer, and cyclist, made the first leap into the guar-laced pool to test the waters before beginning the experiment.

The volunteers swam timed laps in the goop and then in a control pool. Results showed no significant difference in the swimmers' speed in the treated pool compared to ordinary water.

Cussler explained the results with an equation that showed how moving to a gooier medium would slow down a small swimmer, such as a bacterial cell, but not something as large as the human body. For the bacterium to maintain speed, it must keep a smooth flow of fluid over its "body," a feat that's harder in goop, he explained.

"But for humans, it doesn't matter," said Cussler. "When you're big, the important mechanism is just pushing water out of the way," a phenomenon that applies equally to syrup.

The only expense incurred during the no-frills experiment was the cost of the guar, which Cussler bought with consulting fees.

Honored for his research and teaching, Cussler is an expert on distillation who has found ways to purify drugs, gases, and water, among other things. He is a member of the National Academy of Engineering, a distinction currently held by only 2,340 engineers in the United States and abroad, including six of his colleagues in the chemical engineering and materials science department.

DEAN NAMES NEW DEPARTMENT HEADS, CENTER DIRECTORS

Professor **Vipin Kumar** is the new head of the Department of Computer Science and Engineering. He succeeds Professor Pen-Chung Yew, who had held the post since 2000.

Professor **David Lilja** recently succeeded Professor Mos Kaveh as head of the Department of Electrical and Computer Engineering. Kaveh, who served as department head since 1990, became the college's associate dean for research and planning.

Distinguished McKnight University Professor **Timothy P. Lodge** has been selected as the director of the University's Materials Research Science and Engineering Center (MRSEC). He began his new duties on Dec. 1. Lodge is a professor in both the chemistry and the chemical engineering and materials science departments.

Thomas Misa, associate professor of history at Illinois Institute of Technology, will be the new director of the Charles Babbage Institute, effective July 1, 2006. In January, he began the phase-in process, working with current director Arthur Norberg. Also beginning in July, Misa will hold concurrent appointments as Engineering Research Associates (ERA) Chair in the History of Technology, as a faculty member in the Program in the History of Science and Technology, and as professor of history of science and technology within the Department of Electrical and Computer Engineering.

Distinguished McKnight University Professor **Jeffrey Roberts** is the new head of the Department of Chemistry. He succeeds Professor Wayne Gladfelter, who had held the post since 1999.

Distinguished McKnight University Professor **Shashi Shekhar** (computer science and engineering) was recently named director of the Army High Performance Computing Research Center. He succeeds Professor Vipin Kumar, who became head of the Department of Computer Science and Engineering.

Fotis Sotiropoulos joined the Institute of Technology as director of the St. Anthony Falls Laboratory and professor of civil engineering in January. Sotiropoulos formerly was an associate professor of civil and environmental engineering at Georgia Institute of Technology, where he held a joint appointment in the School of Civil and Environmental Engineering and in the G.W. Woodruff School of Mechanical Engineering.

In memoriam

Rutherford Aris

RUTHERFORD "GUS" ARIS, Regents Professor Emeritus of Chemical Engineering, died Nov. 2, 2005, in Edina, Minn. He was 76.

He held a joint appointment in the Department of Classical and Near Eastern Studies, where he conducted research and taught classes in paleontology.

A brilliant scholar, Aris had an enormous impact on the field of chemical engineering through his research, publications, teaching, and advising. Among his most important contributions are detailed explanations for sudden temperature runaways and oscillating behavior of processes involving chemical reactions, work that led to improved design of potentially explosive chemical processes and safer industrial operations.

He led the way in developing new mathematical techniques for optimizing and controlling chemical manufacturing processes and in teaching these new methods to students and professional engineers. He published 13 books and more than 300 research articles, and mentored more than 65 master's and Ph.D. students.

Born in Bournemouth, U.K., on Sept. 15, 1929, Aris completed the requirements for an honors degree in mathematics from the University of London at age 16, but the university did not think it was proper to award a degree to someone so young and delayed giving Aris the degree until he was 19. He later received external Ph.D. and D.Sc. degrees from the University of London.

Aris was hired in 1958 as an assistant professor by Neal Amundson, then head of the University of Minnesota's chemical engineering and materials science department, who had a keen eye for talent. In 1974 Aris succeeded Amundson as department head and served in that capacity until 1978.

FILE PHOTO

Aris was elected to the National Academy of Engineering (1975) and to the American Academy of Arts and Sciences (1988). He received many honorary degrees and distinguished lectureships and more than a dozen prestigious awards from engineering and scientific societies.

Paul Ellis

PAUL ELLIS, professor of physics, died Feb. 20, 2005, at his home in St. Louis Park, Minn. He was 63. Born in Northampton, U.K., Ellis received an undergraduate degree in physics from the University of Bristol in 1962 and a doctorate in physics from the University of Manchester in 1966. He joined the University of Minnesota faculty in 1973. A member of the department's nuclear physics group, Ellis studied the many-body theory of nuclei and nuclear matter at zero and finite temperature using relativistic approaches. Ellis published more than 100 original research articles and co-edited the first two volumes of *Trends in Theoretical Physics*, the first in a series associated with the University's Theoretical Physics Institute. He was elected a Fellow of the American Physical Society in 1998 and received the college's Best Instructor Award in physics for 1980–81.

FILE PHOTO

E. Bruce Lee

E. BRUCE LEE, Vincentine Hermes-Luh Professor of Electrical and Computer Engineering and an IT Distinguished Professor, died April 15, 2005, at age 73.

Lee was the longtime leader of the systems and controls group in the Department of Electrical and Computer Engineering. He was a founder of the Center for Control Science and Dynamical Systems and was its co-director for many years. The strength of his reputation helped attract some of the world's top control scientists and engineers to Minnesota and also helped forge collaborations with faculty and students in several Institute of Technology departments.

During his University career he also served terms as head and acting head of the electrical engineering department and as acting head of computer science.

Lee studied mechanical engineering at the University of North Dakota, earning a bachelor's degree in 1955 and a master's degree in 1956. He received a Ph.D. from the University of Minnesota in 1960. He was a senior research engineer with Honeywell from 1956 until 1963, when he joined the University as an associate professor of electrical engineering.

A leading educator and scholar in his field, Lee supervised more than 50 Ph.D. and numerous master's theses. His book, *Foundations of Optimal Control Theory*, which he co-authored with L. Markus, is considered one of the most influential textbooks in the field.

Lee was elected a Fellow of the Institute of Electrical and Electronics Engineers and a Foreign Member of the Polish Academy of Sciences. He received the Warsaw University of Technology Medal for the development of control theory and the establishment of cooperative research with Polish scientists. He held visiting professorships at California Institute of Technology, Technical University of Warsaw, Université de Montréal, and the University of Florida, and also was a senior visiting fellow at the Science Research Council, England.

George Freier

GEORGE FREIER, 90, retired professor of physics, died May 13, 2005, in St. Joseph's Hospital, St. Paul, after a brief illness.

Freier grew up on a farm near Ellsworth, Wis., and graduated from River Falls State Teachers College in 1938. After receiving his degree he taught science and mathematics in White Lake, Wis., for three years. He received a master of arts from the University of Minnesota in 1941 and worked in the Naval Ordnance Laboratory from 1942 to 1944. Freier received a doctorate in nuclear physics from the University in 1949 but switched to atmospheric physics 10 years later. He joined the physics faculty in 1949 and retired in 1985.

Freier studied the meteorology and physics of large thunderstorms, especially the electrical aspects. He developed a theory of rain formation in which radioactive atoms played a role in nucleation of water to form droplets. He took an interest in weather lore and frequently answered reporters' questions about the validity of weather proverbs. He also wrote a book about weather proverbs.

Christie Geankoplis

CHRISTIE GEANKOPLIS, 84, professor of chemical engineering and materials science, died Nov. 15, 2005, in Edina, Minn.

Geankoplis' research focused on transport processes in biochemical engineering and biochemical reactor engineering. He wrote the chemical engineering texts *Transport Processes and Separation Process Principles*, *Fourth Edition*, and *Mass Transport Phenomena*. He also published more than 50 research articles.

Geankoplis was born June 18, 1921, in Minneapolis and graduated from the University of Minnesota in 1943 with a bachelor of science in chemical engineering. He attended graduate school at the University of Pennsylvania, where he received a master of science in chemical engineering in 1946 and a Ph.D. in 1949.

From 1943 to 1946, Geankoplis was chief engineer for Atlantic Richfield Corporation, where he was in charge of process research to produce aviation gasoline for the armed forces. He was a member of the chemical engineering faculty at Ohio State University from 1949 until 1982, before coming to the University of Minnesota.

Geankoplis was a consultant for 20 years for General Mills Chemicals and for Battelle Memorial Research Institute, Columbus, Ohio.

A fine athlete, Geankoplis was the state high school singles tennis champion in 1939 and won the doubles title twice. He was captain of the tennis team at the University of Minnesota in 1942 and 1943. He was awarded the Big Ten Western Conference Medal in 1943 for the outstanding scholar and athlete at Minnesota, the first time the award ever went to an athlete in a minor sport.

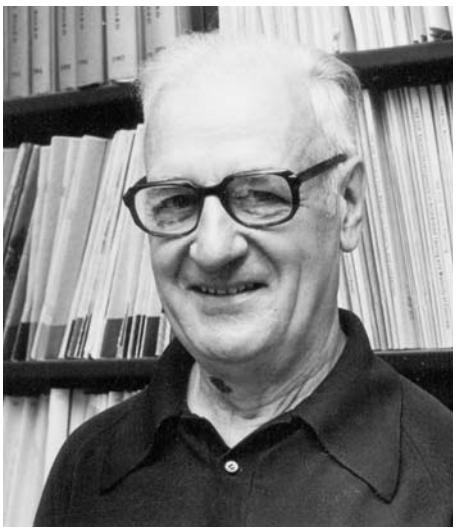
Walter Weyhmann

WALTER WEYHMANN, professor emeritus of physics and former head of the School of Physics and Astronomy, died Sept. 24, 2005, in New Brighton, Minn. He was 69.

Weyhmann received a bachelor of science with distinction from Duke University in 1957 and a Ph.D. in physics from Harvard University in 1963. He joined the University of Minnesota faculty in 1964. He made several important contributions in the area of experimental low-temperature physics, including pioneering techniques in nuclear cooling.

Weyhmann served as head of the School from 1975 to 1982 and as acting head from 1973 to 1974. In 1989 he was appointed associate dean for research in the Graduate School and continued in that position until 1993. During this period he also served as acting dean of the Graduate School for two quarters. He retired in 2001 but continued his research until about a year ago.

COURTESY UNIVERSITY ARCHIVES



FILE PHOTO

Miles Kersten

MILES KERSTEN, retired professor of civil engineering, died Aug. 28, 2005, in Minneapolis. He was 92.

A member of the civil engineering faculty for 33 years, Kersten was instrumental in developing programs in soil mechanics and highway engineering related to soils and pavement design. In his research Kersten concentrated on frost action in the design of highways. He also studied the thermal conductivity of soils, work that still finds application in a variety of problems.

Kersten was born in St. Paul in 1913 and graduated from Minneapolis South High School. He received bachelor's (1934), master's (1936), and doctoral (1945) degrees in civil engineering from the University. In 1935 he took a job as a soils engineer for the Minnesota Department of Highways. He joined the University faculty in 1945 and retired in 1978. After retiring he served as an advisor to the Minnesota Department of Transportation.

He was an honorary member of the American Society of Civil Engineers and a member of the National Society of Professional Engineers. In 1990 the Department of Civil Engineering created the Miles Kersten Land Grant Chair with gifts from the highway industry and friends in Minnesota. In 1995 he received the first Richard P. Braun Distinguished Service Award from the University's Center for Transportation Studies.

FILE PHOTO

Anatoly Larkin

ANATOLY LARKIN, University professor and world-renowned physicist, died unexpectedly Aug. 4, 2005, in Aspen, Colo., where he was attending a workshop. He was 72.

Larkin was a major contributor to the fundamental understanding of superconductivity and the theory of phase transitions. His research was also instrumental to the study of the physics of one-dimensional systems and clusters used in the fields of nanoscience and nanotechnology.

He was born Oct. 14, 1932, in the Moscow region of the former Soviet Union. In 1956 he received a master of science from the Moscow Physical Engineering Institute, where he worked as a researcher for nine years. During this time he received his doctorate from the Kurchatov Institute of Atomic Energy. From 1966 to 1995, Larkin was a department head at the Landau Institute for Theoretical Physics and worked concurrently as a Moscow State University professor for 21 of these years. Larkin joined the University of Minnesota physics faculty in 1995 as the William I. and Bianca M. Fine Professor at the William I. Fine Theoretical Physics Institute.

Larkin was one of the founders of the famous Russian school of theoretical physics. Many of his former students hold leading academic positions at universities and institutes in Russia, the United Kingdom, Germany, the United States, and Israel.

University astronomers discover absence of fine cosmic dust

THE IRON IN YOUR BLOOD was forged in the heart of a massive star, but the gold and silver in your jewelry—plus mercury, lead, and other useful heavy metals—were created when that star exploded in a supernova.

When a supernova explodes, it ejects huge amounts of gas and dust into space, where they become the building blocks of stellar systems like our solar system. Remnants of supernova explosions therefore have much to tell us about the origins of our world.

A team of University astronomers studying the Crab Nebula, a filamentous remnant of a star that exploded in A.D. 1054 in the constellation Taurus, has detected the absence of a type of fine cosmic dust. Images from the new Spitzer Space Telescope, which operates at infrared wavelengths, show none of the tiny dust particles expected to condense out of supernova ejecta.

The finding was a big surprise to the University team's leader, graduate student Tea Temim. Most astronomers expected a young supernova remnant like the Crab Nebula to be packed with micron-wide dust motes. However, the Spitzer images show that the Crab contains only much coarser dust—particles that, although only a few millionths of a meter in size, are still 10 to 100 times larger than the fine stuff.

These images of the Crab—which is located 6,500 light-years away—could not have been made from a ground-based telescope because Earth's atmosphere filters out much infrared light. Spitzer can pick up faint infrared signals only because it is cooled to minus 450 degrees F. If it were much warmer, its own heat would drown out the signals from the Crab.

"The images are exciting because we're filling in the puzzle with infrared," Temim said. "Infrared is where we can find out information about the formation of dust."

Now researchers are beginning work on solving the big mystery: What accounts for the absence of the smallest dust particles?

One possible culprit is the rapidly spinning neutron star at the core of the Crab Nebula. The star is pumping out intense ultraviolet radiation, which might vaporize small particles. The core is also throwing out protons and electrons at rates approaching the speed of light, and they could also be destroying the fine dust. This premise offers an attractive explanation: Fine dust forms within a year of an explosion, but the intense radiation from the core doesn't develop until long after coarse dust has coalesced.

Temim has mapped the energy distribution from these ultrafast particles (called synchrotron radiation) coming from the neutron star. This data will show how these particles spread out and mix with the rest of the ejected material.

Temim's advisors, astronomy professors Robert Gehrz and Charles Woodward, are among the co-authors of the research paper, which was presented recently at an American Astronomical Society meeting. The study has been highlighted in articles in *Science* and *Astronomy* magazines.

A team of University of Minnesota astronomers took this picture of the Crab Nebula, a wispy remnant of a supernova that exploded in A.D. 1054. Images from the new Spitzer Space Telescope, which operates at infrared wavelengths, show none of the fine, micron-wide dust particles expected to condense out of supernova ejecta.

NASA/JPL/SSC/R. GEHRZ, T. TEMIM, C. WOODWARD (U OF M), T. ROELLIG (NASA/ARC)

David Gasperino

JAYME HALBRITTER

ON A COLD, DAMP MINNESOTA MORNING, David Gasperino sat in the corner of a Stadium Village coffee shop, his expression a model of intense concentration. Anyone who didn't know the chemical engineering graduate student might have assumed he was preoccupied with an upcoming test, paper, or presentation.

But education wasn't on Gasperino's mind—not the kind of education one gets in a classroom, anyway. He believes that engineering students can make a positive difference in the world—right now—and he's on a personal quest to transform their ideals into action and education.

More than 30 Institute of Technology engineering students who share his convictions came together to form Engineers Without Borders–University of Minnesota, of which Gasperino is president.

The group is the first Minnesota chapter of Engineers Without Borders–USA, which links engineering students and professionals nationwide with developing communities around the world. Students work on small-scale engineering projects developed in partnership with community residents.

"I think in every engineering class there are people who have a deep interest in social issues," said Gasperino. "I want to make sure there are ways for those people to make a difference through their disciplines and perhaps shape their careers in a positive way."

Most Engineers Without Borders projects focus on improving energy sources or creating clean water supplies, but others address such issues as the digital divide and enterprise development. All projects are designed to be environmentally and economically sustainable while giving students the chance to broaden their education.

Engineers Without Borders–USA was founded in 2000 by an engineering professor at the University of Colorado. The nonprofit humanitarian organization currently has more than 100 active projects in 30 countries, including the United States, Guatemala, Peru, Ghana, China, India, Niger, and the Dominican Republic. The group has 87 university and 32 professional chapters nationwide.

CARING FOR OTHERS NEAR AND FAR

Not that long ago, Gasperino was working toward a bachelor's degree in chemical engineering at the University of Washington. He noticed that many Sudanese refugees living in the area lacked warm clothes for winter. He and his friends began visiting fraternities, sororities, and student-housing laundry rooms to collect unused or discarded winter clothing to give to the refugees.

"You'd hand them a coat, they'd take it from your hands and put it on right away. It felt good to know

Engineering A Better World

Students form state's first chapter of Engineers Without Borders

we were helping people," he said.

Those acts of kindness provided immediate relief to people in need, but Gasperino and the Minnesota students are discovering that making a difference through Engineers Without Borders will require more patience.

During its first year the University chapter elected officers, shared ideas, and began searching for a project, a process that entails significant hurdles.

All projects must satisfy selective criteria established by the national organization. The rigorous application process takes time, and chapters must fund their own projects. And then there's the issue of finding a project with enough opportunities for hands-on work.

"It's been difficult to find a project where everyone who wants to be involved can be involved," admits Gasperino. "But we've got two good ones now that we're trying to get off the ground."

BUILDING STRONGER COMMUNITIES

In February 2005 the group partnered with the Engineers Without Borders chapters at the University of Wisconsin–Madison and Seattle University to work on a project in Doi Santi, Thailand. A small village comprised of 38 huts, Doi Santi is vital to the future of children in the region.

Most of Thailand's schools are located in large urban areas. Traditionally, the hill tribes of northern Thailand have regarded formal education as a threat because elders fear their children will not return home after experiencing city life.

With the aid of Engineers Without Borders–USA, Thai officials plan to transform Doi Santi, the only area village with an elementary school, into an educational hub serving families from 10 rural communities. The goal is to develop a community-based boarding school that educates the children within their cultural environment. Doi Santi's proximity to the other villages will allow students to visit on weekends and maintain close ties to their families.

The project will convert the school from one small building into a larger complex with student dormitories and a water sanitation system.

After joining the project, the Minnesota students began planning drainage and erosion-control measures, as requested. But progress has slowed because they have had to spend most of their time building bridges to potential donors.

"We are working on creating a water sanitation system for the village and the school," said Vladimir Makarov, an electrical engineering student and the chapter's treasurer. "Unfortunately, it will take us a little longer than we originally anticipated."

The project's scope—planning, designing, and labor—means that several University students will have to spend up to two weeks in Doi Santi completing the project. The chapter must raise about $20,000 to support its participation.

"We're going to raise the money," Makarov said. "We're going to do it because we believe that people are equal—they just live in different circumstances. If we can help provide an education for the people living in those villages, we can change their circumstances for the better."

A BETTER WORLD CONTINUES ON PAGE 39 ▶

ENGINEERS WITHOUT BORDERS

University engineering students are helping to build a student dormitory for Doi Santi, a village in Thailand's Chiang Mai province. The project is a major step in creating a regional school for 10 remote hill tribe communities.

WRITTEN BY

STEVE LINDERS

Steven Crouch

Leading by Example

Dean outlines vision for the college at a pivotal moment in U's history

WRITTEN BY
RHONDA ZURN

NOW THAT HE IS DEAN of the Institute of Technology, Steve Crouch is ready to start bragging. True to his nature, however, the straightforward, unassuming leader won't be bragging about himself. Instead, he wants others to know about the strengths and achievements of the college.

"I believe that the Institute of Technology is one of the strongest colleges within the University of Minnesota," Crouch said. "Many people don't know about our highly ranked academic programs, top researchers, and research centers with world prominence. It's important for all of us to tell our story so we can continue to secure resources and attract top-notch faculty, staff, and students who will carry us into the future."

> "I think one area where we could achieve some real prominence is in nanomedicine, especially in relation to research that could lead to new medical devices."

Crouch is proud of the college's legacy of breakthrough research and inventions, but he has set his sights on the future. He points out that the University needs strong Institute of Technology programs in science, engineering, and mathematics in order to reach its goal of being one of the world's top three public research universities.

FOCUS ON THE FUTURE

Since becoming dean in January 2005, Crouch has held numerous meetings to tell the college's story and share his vision for the future.

Four broad, interdisciplinary areas form the nucleus of that vision: medical-device technology, nanotechnology, renewable energy, and digital technology.

"These priorities have received interest and support in the past and in some way involve almost every area of engineering, science, and mathematics within the Institute of Technology," Crouch said. "They also involve us working closely with the College of Biological Sciences, the Academic Health Center, and others."

He is convinced that maintaining these relationships is vital to the future of science and engineering programs. Furthermore, he believes, the Institute of Technology's future will be tied closely to the college's success in the biological and health sciences—and to its selectivity in pinpointing target areas within these broad categories.

"I think one area where we could achieve some real prominence is in nanomedicine, especially in relation to research that could lead to new medical devices," he said. "The University is uniquely positioned here because of strong relationships that our college's scientists and engineers have with the Medical School and medical-device companies in Minnesota."

Another of the dean's long-term goals is to secure resources to fund a new physics building with an attached nanotechnology center, a project that was recently made part of the University's six-year capital plan.

"I see this capital request as very critical to the future health of this college and to the University as a whole," Crouch said.

Attracting and retaining the most talented young scholars from a diverse student population also is a high priority.

"Some of our new programs focus on incoming students and students in middle school and high school," Crouch said. "The goal is to make sure they have the science background and educational support to succeed when they arrive at the University."

JONATHAN CHAPMAN

THE MAN BEHIND THE VISION

As might be expected of a dean, Crouch is the Institute of Technology's strongest advocate, but his heartfelt dedication to the college and the University is rooted in personal experience.

A private man who rarely talks about his personal life, he nevertheless is quick to credit the University with altering the course of his life.

Crouch, 62, grew up in southwestern Minnesota in the small town of Sleepy Eye. His father died when Crouch was nine, and his mother died seven years later. The young man went to live with a relative of a friend and finished high school in 1961.

"My mother had always encouraged me to think big—to be a doctor, lawyer, or engineer," Crouch said. "When I knew I wanted to become an engineer, the place to go for engineering school was the Institute of Technology at the University of Minnesota."

> "My mother had always encouraged me to think big—to be a doctor, lawyer, or engineer."

He worked his way through school at various jobs, including stints as a janitor at the University's animal hospital and as a busboy in a sorority house. When his academic advisor offered him an opportunity to work in a research laboratory, Crouch initially resisted because he was earning $1.44 an hour as a janitor as compared to the $1.25 hourly wage he would make in the lab.

Later that spring he decided to take the lab position but kept the other two jobs—all while carrying 18 credits. Realizing that he was "not having much fun," however, he decided to chuck it all and join the U.S. Navy.

Fate intervened when Crouch broke his leg while playing in an intramural softball game. The Navy was no longer an option, and the injury also forced him to quit working as a janitor and busboy. The laboratory job was all he had left, but his experience there changed his life.

"I realized how much I loved to do research, and I was getting paid to do something I loved," he said.

While he was at the University, something else happened to Crouch that would change his life forever—he met his future wife.

"We met on a blind date through my sister, when Steve was a junior," said Karen Crouch, who also was a student at the time and now is an academic advisor at the University. "My sister enticed me to meet this guy she said was 'really cute, played football in high school, and was very smart.' We went on the date, and the rest is history." Married for 40 years, the couple has three adult children and three grandchildren.

Crouch received his bachelor's, master's, and doctoral degrees in mineral engineering from the University (in 1966, 1967, and 1970, respectively).

In 1964, while working as an undergraduate lab assistant, Crouch met a visiting researcher who was director of the Mining Research Laboratory of the Chamber of Mines of South Africa. The industry-supported research organization was considered then to be the premier place in the world for research in rock mechanics, an area in which Crouch had decided to specialize. He was invited to South Africa in 1968 to become a research officer in the lab while working on his Ph.D. thesis.

"My wife and I really enjoyed our years in South Africa," Crouch said. "The way of life there was so different. For example, at that time no one there had television. I remember listening to radio news reports about the 1969 moon landing, sitting in front of a coal fireplace in the dead of a July winter in South Africa."

Crouch returned to Minnesota in 1970 to join the University faculty as an assistant professor in what is now the Department of Civil Engineering. He later was promoted to associate professor and professor. From 1987 to 1997 he served as department head and in 1997 became the college's associate dean for finance and planning. In 2005 he was named dean.

In his time away from work, Crouch enjoys fly-

When not at work, Crouch enjoys his time with family. He is pictured here with his three grandchildren, (left to right) Erin, 7, Natasha, 2, and Connor, 8. Crouch has three adult children and has been married to his wife, Karen, for more than 40 years.

fishing, gardening, woodworking, furniture making, and reading.

"When I first started fly-fishing I had to really concentrate on delivering the fly in the right way in the right place," he said. "I had to concentrate so much that I really couldn't think about much else, so it was a good way for me to flush my mind of everything else."

Crouch also enjoys getting outdoors to do some backyard gardening. According to Karen Crouch, in the early spring their house often doubles as a makeshift greenhouse.

"Every spring our living room is filled with Steve's flats of seedlings sitting on tables by the windows," she said.

Crouch and his wife have lived in the same house for 33 years. During that time Crouch has made some of the home's furniture, including several dining room tables and desks used by their children as they were growing up.

"Steve and I love being in the home where all of our children grew up and where we still enjoy many family gatherings," Karen said.

LEADERSHIP FOR CHANGE

Over the years the University has been Crouch's home away from home and the focus of his professional life. On most days, a predawn stroll past Walter Library will find the lights in his corner office shining brightly, and if not, it's safe to assume the dean is en route to a breakfast meeting.

No one was surprised when this highly regarded leader with a robust work ethic was picked to lead the Institute of Technology at a pivotal moment in the University's history. In many ways, his leadership style is quintessentially Minnesotan—down-to-earth, hardworking, progressive, and sensible—traits that will serve the college well as the University undergoes a far-reaching transformation.

"I've worked very hard over the last 35 years to establish a reputation for being honest, fair, and forthright," Crouch said. "I can't always tell people 'yes' or give them what they want, but I believe very strongly that they need to be treated fairly. I don't make 'secret deals' with anybody."

Crouch said he wanted to be dean for the same reasons he wanted to be department head years ago. "I have ideas for improvements, and I want to be the one to lead people through the change," he said.

In his first year as dean, he said, he is most proud of building his team, which includes new college administrators, three new department heads, and four new center directors. Crouch said he also has worked hard to rise above University politics and to continue collaborations with other University colleges, especially in relation to the University's strategic positioning.

"The University talks about transformational change, not small, incremental change," Crouch said. "I hope that by the time I'm done as dean, I will have been able to be a part of leading some of that transformational change."

Now that would give anyone, even someone as modest as Crouch, something to brag about. ■

> "I can't always tell people 'yes' or give them what they want, but I believe very strongly that they need to be treated fairly."

FOR MORE INFORMATION see www.it.umn.edu/about/crouch.html

Steven L. Crouch

Personal > Age 62; grew up in Sleepy Eye, Minn.; married 40 years; three adult children and three grandchildren

Education > Bachelor's, master's, and doctoral degrees in mineral engineering from the University of Minnesota

Career > Research officer, Mining Research Laboratory of the Chamber of Mines of South Africa (1968–1970); assistant professor, professor, department head, associate dean, and dean, University of Minnesota (1970–present); Theodore W. Bennett Chair in Mining Engineering and Rock Mechanics, Department of Civil Engineering (1997–present)

Research > Early research dealt with the stability of underground mine openings; later research studied numerical stress analysis techniques for fiber-reinforced and particulate-composite materials

Awards > Charles W. Britzius Distinguished Engineer Award from the Minnesota Federation of Engineering, Science and Technology Societies; U.S. National Committee for Rock Mechanics Applied Research Award; and Minnesota Council on Quality Award

Hobbies > Fly-fishing, gardening, woodworking, furniture making, and reading

POWER Players

Survey confirms Institute of Technology's role as economic engine

PROFILES WRITTEN BY
JUDY WOODWARD & AMY BARRETT
PHOTOS BY
JONATHAN CHAPMAN

Institute of Technology (IT) alumni are well aware of the impact the college and the University of Minnesota have had on their lives. Recent survey results show that the entrepreneurial spirit of IT alumni also has had a deep impact on the economies of the state, nation, and world.

Results of a survey released by IT in late spring 2005 show that about 4,150 alumni-founded companies active today employ more than half a million people worldwide and generate $90 billion in annual revenue.

About two-thirds of the companies are based in Minnesota. These companies employ more than 175,000 people and generate approximately $46 billion in annual revenue.

Companies founded by IT alumni span many high-tech fields, including manufacturing, biotechnology, communications, software, electronics, and engineering. But alumni also branched out into other fields, from health care to the hospitality industry.

"The survey turned up twice as many companies as we had expected, and their economic impact is just amazing," says Mostafa Kaveh, IT's associate dean for research and planning. "Clearly, IT has a huge impact on our state and the nation, and our college is just one example of the University's powerful economic engine."

Many alumni who founded companies reported that they gained experience early in their careers at companies founded by other IT alumni. Control Data and Medtronic, for example, served as the training ground for the founders of more than three dozen companies.

The survey updates a 1993 project that identified more than 1,000 companies with roots in IT. At the time, these companies collectively employed more than 150,000 people and generated annual sales in excess of $20.3 billion. The current survey, conducted in fall 2004 by Questar and supported by a grant from the Mr. and Mrs. George W. Taylor Foundation, drew more than 15,000 responses from the college's 48,000 alumni.

WHAT MAKES THEM TICK?

So who are these entrepreneurs and how did they achieve success? The following stories profile eight alumni, founders of companies large and small, tracing their paths from University student to business leader. A willingness to take risks, an ability to find solutions to problems, and a vision for the future are the common threads that tie together these stories of success. >>

IT FOUNDERS 2005

WORLDWIDE
ACTIVE COMPANIES
4,150
EMPLOYEES
551,000
ANNUAL REVENUE
$90 BILLION

IN MINNESOTA
ACTIVE COMPANIES
2,600
EMPLOYEES
175,000
ANNUAL REVENUE
$46 BILLION

FOR MORE INFORMATION or to download the complete *IT Founders 2005* report, see www.it.umn.edu

Earl**BAKKEN**

The man who created an industry

One day during the 1930s when Earl Bakken was a nine-year-old kid growing up in Columbia Heights, Minn., he went to see the movie *Frankenstein*. For Bakken it was a thrilling experience. "I said, 'That's what I want to do—bring people back to life with electricity'," Bakken remembered.

It's probably safe to say that thousands of young boys back then were dazzled by the cinematic bolts of electricity that reanimated the clumsily stitched-together monster played by Boris Karloff. But only one of them—Bakken—grew up to found a whole industry on the idea.

In 1949, only a year after graduating from the University with a degree in electrical engineering, Bakken co-founded Medtronic in a northeast Minneapolis garage. In 1957 he worked with the University to invent the world's first reliable cardiac pacemaker, the groundbreaking device that produces electric impulses to regulate the rhythm of a flagging heart.

Every six seconds someone somewhere in the world receives a Medtronic implant.

Today, Medtronic has 34,000 employees worldwide and produces a mind-boggling range of devices designed, in the words of its founder, to "rebuild people to be...normal." From defibrillators and implantable insulin pumps to stimulation devices for the brain and muscles to pacemakers that govern medical problems as diverse as incontinence and obesity, there's hardly an organ of the body that is beyond the help of a Medtronic device. Every six seconds someone somewhere in the world receives a Medtronic implant.

Through the years Bakken has remained famously loyal to the University that helped give him his start. Now a resident of Hawaii, he returns several times a year to visit the University and confer with administrators and researchers. "I still love getting together...," he said.

At 82, Medtronic founder Earl Bakken is quick to point out that he's "still working" on projects ranging from the support of environmental research in Hawaii to the development of innovative healing techniques that partner sophisticated medical technology with traditional "high touch" healing methods like massage and acupuncture.

One event that always brings him back to Minnesota is Medtronic's annual convocation of some of the company's living success stories.

"In December we bring in six patients who have our devices," he explained. "They come with their doctors. The doctors tell why the devices were implanted, and the patients talk about the difference the devices have made in their lives." The meeting, which is broadcast to Medtronic's employees around

> "Working with the U has created many of our products over the years."

the globe, is an opportunity for them to "see the difference that their work has made."

Bakken values Medtronic's historically close relationship with the University. "Working with the U has created many of our products over the years," he said.

He also maintained friendships with faculty, including the late Otto H. Schmitt, professor of physics and electrical engineering, whom he describes as a "great leader and thinker" who helped train many of Medtronic's future leaders.

Bakken's connection to the University's Institute of Technology stretches back to the years right after World War II, when he studied electrical engineering. "I had good teachers in electrical engineering," he recalled.

He also noted tongue-in-cheek that the Institute of Technology might have had a previously undisclosed role in jump-starting his entrepreneurial career.

In graduate school Bakken indulged his love of mathematics by taking three courses in the discipline simultaneously. "Then I got into advanced thermodynamics in physics. That threw me, kinda." He paused. "So I dropped out [of grad school] and started Medtronic."

Bakken has more than recovered from his status as a grad school dropout. To date, four institutions, including the University, have awarded him honorary doctorates. His record of service to Minnesota and to his adopted state of Hawaii has earned him numerous honors, including the Outstanding Achievement Award, the University of Minnesota's highest alumni award. His list of professional honors is a virtual catalog of awards in the fields of engineering, health, business, and philanthropy.

At 82, Bakken is quick to point out that he's "still working" on projects ranging from the support of environmental research on the "Big Island" of Hawaii to the development of innovative healing techniques that partner sophisticated medical technology with traditional "high touch" healing methods like massage and acupuncture. He has helped the North Hawaii Community Hospital grow into a showcase for what he calls "blended medicine."

"Most hospitals are warehouses for sick bodies," he said. "This hospital is built for patients."

Bakken's focus remains resolutely on the future. In the mid-1970s he founded the Bakken Library and Museum in Minneapolis to share with a younger generation his fascination with electricity. In the 1980s he helped launch the Pavek Museum of Broadcasting, located in St. Louis Park, Minn. Both museums share the goal of fostering interest in engineering as a career.

"We need so many engineers," Bakken said. "We're getting short of them in the U.S. Other countries are beating us in training engineers. The Bakken and the Pavek train a lot of kids. We hope we can get some of them to [attend] the University."

Bakken also remains interested in new areas of research at the University. Regents Professor Lanny Schmidt of the chemical engineering and materials science department, an expert on renewable energy resources, said that on a recent trip to the Minneapolis campus Bakken called to ask if he could visit Schmidt's lab.

Schmidt was impressed with Bakken's enthusiasm for renewable energy and his support for developing alternative energy sources near his home in Hawaii. "He's a fantastic fellow," Schmidt added.

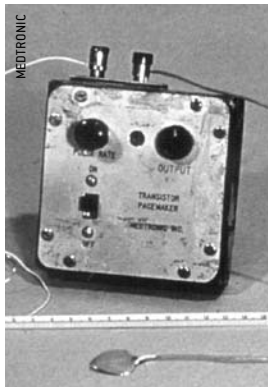
Ironically, Bakken may have achieved an even more personal understanding of the importance of his life's work in recent years. "I have Medtronic stents in my heart and an implanted insulin pump. I keep going only because of Medtronic," he quips.

When asked to sum up the deepest satisfaction of his long life, he doesn't hesitate: "What could be better work than knowing that you're restoring someone as a whole person in body, mind, and spirit?" ■ JW

BIG BUSINESS

Nineteen companies on the 2005 "*Star Tribune* 100" (the newspaper's list of the 100 largest public companies in Minnesota) were founded by IT alumni:

- ADC Telecommunications
- ASV Inc.
- August Technology
- CNS Inc.
- Ceridian
- Compex Technologies
- CyberOptics Corp.
- Datalink Corp.
- Digital River
- Donaldson Company
- Fastenal
- Hawkins Inc.
- MGI Pharma
- MTS Systems
- Medtronic
- Pemstar
- Pentair
- Possis Medical
- RTW Inc.



In late 1957, after only four weeks of work, Medtronic delivered the world's first wearable, battery-powered, transistorized cardiac pacemaker to surgeons at the University of Minnesota. Within hours the device was helping keep a pediatric heart patient alive.

MEDTRONIC

Brian**BROCKWAY**

The heart of a thriving business

Back in 1979, when Brian Brockway graduated from the University with a master's degree in electrical engineering, the last thing on his mind was starting a company. Today he runs a business with 200 employees and annual sales of $25 million.

"Back then I wasn't even interested in getting involved in business as a manager," he said.

That changed after he went to work at Cardiac Pacemakers Inc. (CPI), now a division of Guidant.

"I started listening to people talk over lunch about certain decisions that were made, and I became curious about why things were being done," he said. He started reading books by CEOs and entrepreneurs and became so intrigued with business that he left CPI to start his own company—Transoma Medical—in 1983, when he was only 29 years old.

"I was extremely naive," he said. "At that age you think you're invulnerable, that you can do anything, but it's not so easy."

Transoma (a Greek word meaning "through the body") manufactures wireless, implantable devices that help monitor the health of laboratory animals involved in drug safety research. The company is headquartered in Arden Hills, Minn.

Brockway's success as an engineer-turned-CEO has made him something of a celebrity in the biomedical community, even landing him on the cover of the September 2004 issue of *Minnesota Business* magazine.

"For our type of business, Minnesota is hands-down the best place in the world to be," he said. "When technology and innovation are such a big piece of the business, you need to be where you can hire the best people, and there's a great pool of talent in this area."

> **"For our type of business, Minnesota is hands-down the best place in the world to be."**

Brockway's current challenge is to adapt the monitoring technology so that it can help keep human heart-failure patients out of the hospital and emergency room. For example, a wireless pressure sensor implanted in a person's heart could alert a physician to a dangerous change in blood pressure. The doctor could then intervene immediately, possibly with a solution as simple as telling the patient to take an extra half pill of diuretic (a drug commonly prescribed to eliminate excess fluid from the body). This activity would happen before the patient was aware that anything was wrong.

"It's kind of like a guardian angel for a heart-failure patient," he said.

FDA approval for the device would give Transoma access to an estimated $750 million market, in

Transoma Medical manufactures wireless, implantable devices that help monitor the health of laboratory animals involved in drug safety research. The company is now adapting the monitoring technology so it can be used to track serious health conditions in humans.

The origins of Brian Brockway's success as an engineer-turned-CEO can be traced to the experience he gained as an electrical engineering graduate student working with Dr. Franz Halberg. Brockway created an implantable monitor that was used in lab animals to wirelessly transmit data to researchers. Years later he founded his business on the technology.

which his relatively small company would compete with medical-device giants like Medtronic or Guidant, where his wife is a scientist.

Brockway, the father of five children, grew up on a farm in southwestern Minnesota. His interest in technology dates back to fifth grade, when a friend gave him an electronics kit for his birthday.

"After the party I opened it up and immediately became fascinated with electronics," he recalled. He also took up ham radio, building his own transmitters, antennas, and receivers whenever he wasn't in school or helping out on the farm. He soon decided to be an electrical engineer when he grew up.

His three older brothers had attended the University, and Brockway saw no reason to break with tradition. But what really sold him was the University's marching band. A trombone player in high school, he was truly dazzled when he visited campus and watched one of his brothers perform in a marching band roughly the size of his hometown.

He went on to march in the band for four years, until he completed a bachelor's degree in electrical engineering in 1975.

"The education I got at the U really wasn't about circuits, electronics, or semiconductor physics," Brockway said. "It was really about important fundamentals—how to creatively come up with solutions to problems and how to learn things quickly."

That's what Brockway spends most of his time doing these days as Transoma's CEO.

"From figuring out where the product line is going to caring for customers to dealing with a problem in HR, running a business is really all about creative problem solving," Brockway said.

Obviously, this entrepreneur isn't so naive anymore. ■ AB

> "Running a business is really all about creative problem solving."

John**CHEUNG**

Cutting out a path to success

For many entrepreneurs, the most difficult risk is the first—mustering the courage and self-confidence to go it alone.

John Cheung, who received his undergraduate, graduate, and doctoral degrees from the University, would agree with that assessment. Cheung is the founder and chairman of OMAX Corporation, a manufacturer of sophisticated precision water-jet machining equipment, headquartered in Kent, Wash.

But when Cheung talks about that audacious first step, he isn't referring to the day he and his business partner decided to found OMAX. It's the decision he made 45 years ago when he was a teenager in Hong Kong.

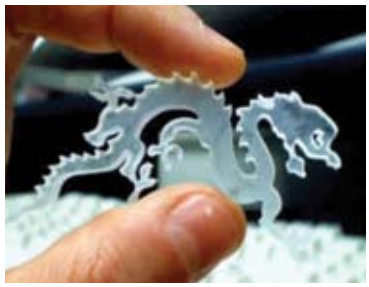
He took the biggest risk of all when he left his family and home for a remote place called Minnesota in order to study at a university he'd barely heard of before. It was a gamble in every sense of the word, but Cheung succeeded brilliantly.

"Being a foreigner and leaving home as a teenager trained me to be less sensitive to what is called risk," said Cheung, who believes his early training in self-sufficiency helped him make the switch from engineering researcher to independent entrepreneur. You might say it was simply a matter of doing what followed logically from his education in the University's Institute of Technology.

"My previous company used water pump technology to set up new companies. When [my partner and I] got the idea of [using a] water jet as a machining tool, it wasn't a big leap of faith to say, 'We'll do it on our own.' So we started a business."

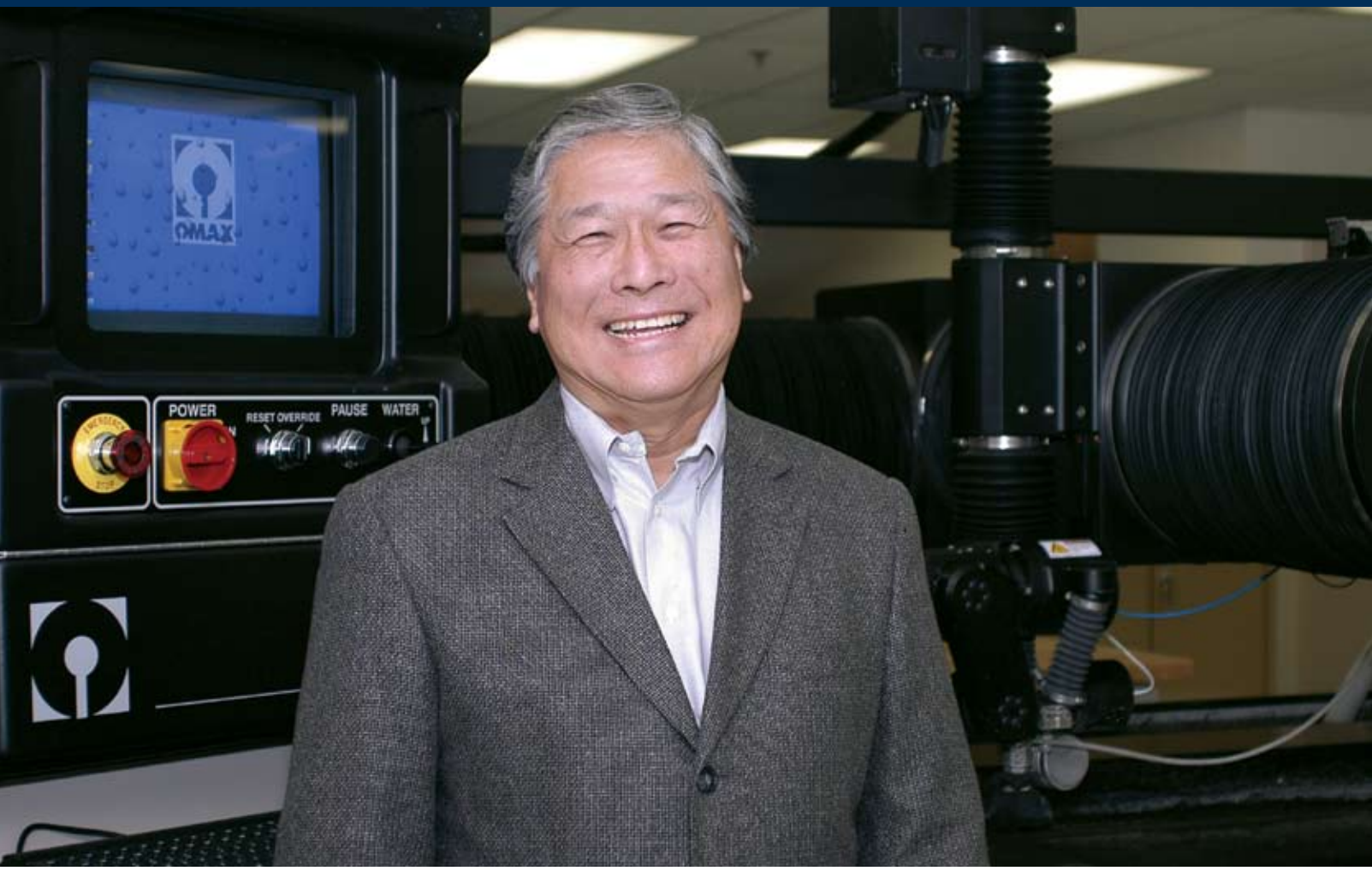
Although Cheung never formally studied business administration, he said that his education (bachelor of science in aeronautical engineering, 1965; mas-

> "Being a foreigner and leaving home as a teenager trained me to be less sensitive to what is called risk."



OMAX CORPORATION (3)

Although most of OMAX's business involves machining parts for industrial applications, design studios often use OMAX equipment to make intricate stone, metal, and tile designs. Princess Cruises and several Las Vegas casinos are among the customers that have used OMAX machines to produce decorative art.



OMAX CORPORATION

ter of science in mechanics, 1967; and doctorate in mechanics and materials, 1970) gave him important tools for a business career.

In studying science and engineering, Cheung said, students learn how to solve a problem using the fundamentals—a technique that transfers well to the business world.

"When confronted with any new problem," he explained, "I say, 'What is involved and what is a logical approach to handling it?'"

After earning his doctorate, Cheung worked at the U.S. Bureau of Mines, where he researched high-speed water-jet technology as a method of breaking rocks for mining excavation.

OMAX was born in 1993 when Cheung recognized the technology's potential as a precision tool that could hew a delicate butterfly from a block of stone.

Although most of OMAX's business involves machining parts for industrial applications ranging from automotive components to medical appliances, Cheung is delighted that his equipment is also used by design studios for intricate stone, metal, and tile inlays and for other decorative fabrications. Several Las Vegas casinos and Princess Cruises are among the customers that have used OMAX machines to produce decorative art. On working with design-oriented clients, Cheung said, "It's fun for us."

He acknowledges the importance of his engineering and science background but also remembers a critical lesson in human relations he learned from his undergraduate advisor, aerospace engineering and mechanics professor Robert Plunkett.

In their first encounter, Plunkett asked the young student where he was living. Cheung, who had resisted the temptation to create a little island of home by rooming with other Chinese students, replied that he was living with some American graduate students.

"Great," Plunkett replied. "Otherwise, [if you were living in a Chinese-speaking environment] I would tell you to move out right now!"

Cheung said his advisor was right: "That way I could learn American ways. It was great business advice."

When it came to his personal life, however, Cheung made his own decisions and married a woman from Hong Kong. They now have three children and several grandchildren.

When he isn't working, he likes to practice another skill picked up in Minnesota. "I learned to fish by catching bass in Lake Minnetonka," he noted.

It's been a satisfying life, said Cheung, and there's one thing that makes him proudest of his success as an entrepreneur. "I [was] able to get into the business side and still maintain my integrity." ■ JW

John Cheung's history with water-jet technology dates back to 1973, when he worked as a research engineer in the U.S. Bureau of Mines. He is an accomplished engineer who founded or co-founded three other businesses before starting OMAX in 1993.

Bob**GOWER**

Investment in small invention leads to big business

University alumnus Bob Gower had his postretirement plans all worked out. After leaving Lyondell Petrochemical in 1996, he would buy some small companies and improve their operations.

"I planned to do that on a small scale," he said.

Instead, he now finds himself on the leading edge of what the National Science Foundation predicts will be a $1 trillion global marketplace by 2015.

It all started with a phone call from a friend who invited him to a meeting with the late Dr. Richard Smalley, a professor at Houston's Rice University and world-renowned pioneer in nanotechnology. Smalley, along with two other scientists, had received the 1996 Nobel Prize in chemistry for discovering fullerene, a new form of carbon. The breakthrough discovery led to an explosion of nanotechnology research, including Smalley's development of the carbon nanotube.

"I don't know anything about it, and I don't know if I'd be willing to invest or not," Gower told the friend who invited him to meet Smalley, "but I don't know any Nobel Prize winners, so I'll come just for that."

During that fateful meeting, Gower became increasingly intrigued as Smalley described possible applications for carbon nanotubes—stronger car bumpers and bulletproof vests, fuel cells capable of powering cell phones and laptops for weeks at a stretch, maybe even a more effective way to fight cancer.

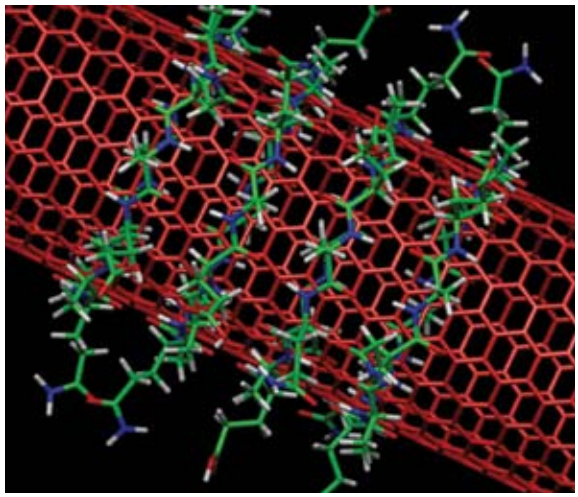
Carbon nanotubes, often called "buckytubes," resemble tiny rolled-up pieces of chicken wire that measure only a billionth of a meter in diameter. The tubes, made of carbon atoms, are noted for their strength (100 times stronger than steel at one-sixth the weight), electrical conductivity, and thermal properties. They show great potential for a wide range of commercial applications.

"We decided this was something worth trying to build a business on," Gower said. "What we're trying to do is to take a transforming technology—transforming in the same sense as computers and the Internet—into commercial activity."

Gower invested in Houston-based Carbon Nanotechnologies, Inc. (CNI) and signed on as president and CEO. The company's subsequent growth and success confirm that the marriage of Smalley's patents in nanotube production and Gower's business acumen is a winning combination.

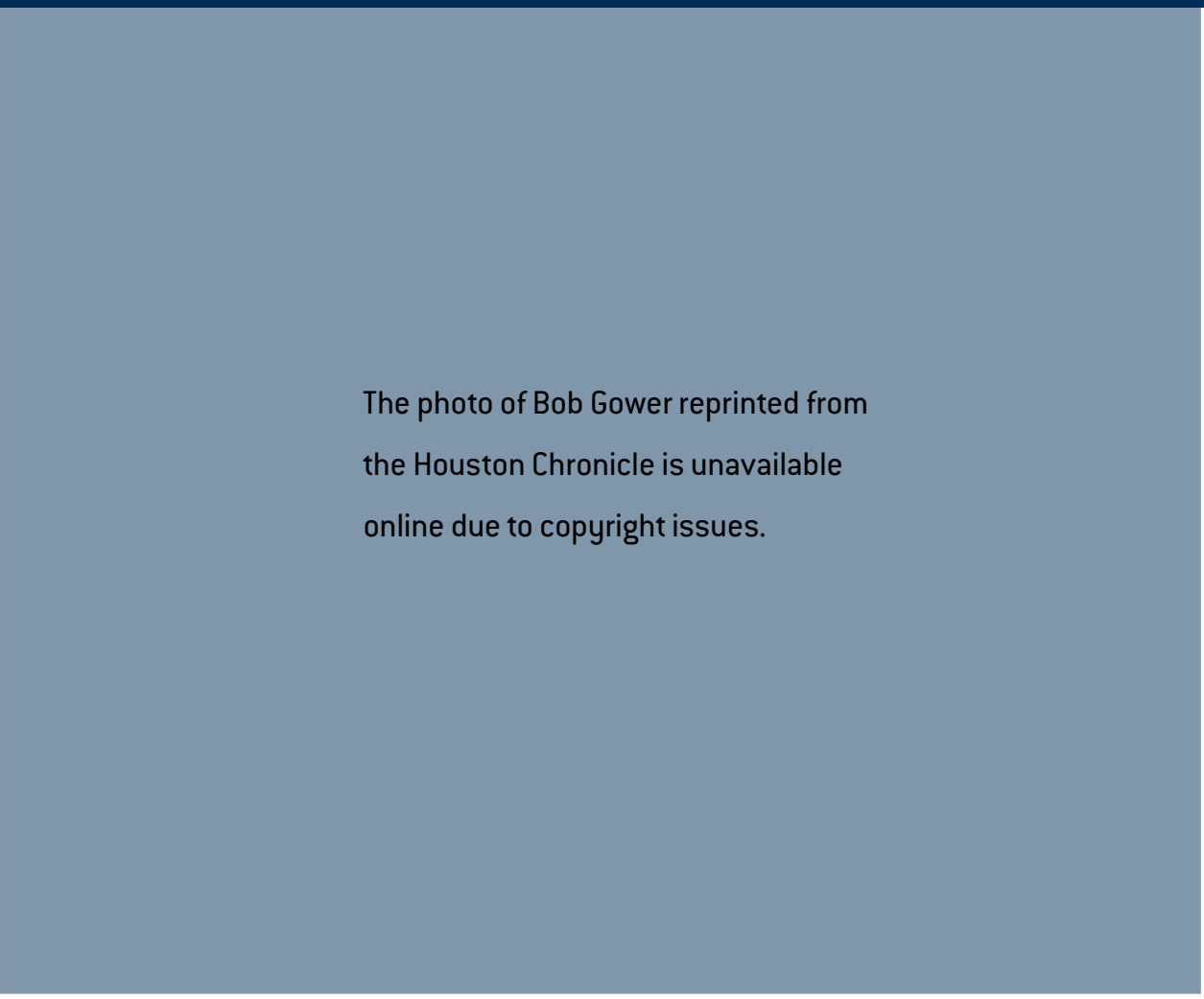
"It's one thing to have a strong patent position, but it doesn't make much difference if you can't make and sell the material," said Gower.

Gower had learned many important life lessons throughout his career. After earning a Ph.D. in organic chemistry from the University in 1963, he worked in research and later moved into operational and managerial positions for companies such as Sinclair and Atlantic Richfield before joining Lyondell, where



CARBON NANOTECHNOLOGIES, INC.

Carbon nanotubes, also called "buckytubes," resemble tiny rolled-up pieces of chicken wire that measure only a billionth of a meter in diameter. The tubes, made of carbon atoms, are noted for their strength, electrical conductivity, and thermal properties. This graphic of a buckytube shows it wrapped with four peptide rings.



According to Bob Gower, president and chief executive of Carbon Nanotechnologies, Inc., about a dozen of the 30 patents the company holds related to carbon nanotubes will give it the lock on what is expected to become a booming market.

he became president and then chairman.

"Getting the Ph.D. was extremely important to me," Gower said. "It convinced me that I'm relatively capable and can do a wide range of things."

Family and community have also been important to Gower throughout his career. He and his wife have been married for 46 years and have three daughters, all living in the Houston area, where Gower has been active in his church, with the United Way, and on the board of a dropout prevention program.

Gower credits the late Edward Leete, a professor of organic chemistry who was his advisor at the University, with helping him acquire the knowledge and confidence he needed to become a successful business executive and entrepreneur. Running a company requires total self-confidence and the certainty that you can get the job done, said Gower, and Leete expected no less from his doctoral students.

"His typical manner was to give whatever amount of assistance you asked for," Gower said. "I wanted to prove I could do things on my own, and for the most part, he was willing to let me do that."

CNI's success certainly proves that Gower is adept at doing things on his own. Today the company has about 700 clients, many of which are located in Asia. Among them is South Korean electronics company Samsung, which hopes to have a flat-screen nano TV on the market by late 2006. Meanwhile, corporate research and development departments around the world are racing to perfect and patent other applications for nanotubes before their competitors.

> "It's hard to think of an industry that wouldn't have an application for nanotubes."

So far, CNI has been supplying nanotubes free to many of its customers for research purposes. In exchange, if any of those customers markets a product that uses nanotubes, the client will purchase at least three-quarters of its supply from CNI. The company has been ramping up its production capabilities so that when the demand hits—when, not if, according to industry observers—CNI will be ready.

Although CNI is not the small-scale business venture he'd planned for his retirement, Gower is certain that small-scale technology is going to be big.

"It's hard to think of an industry that wouldn't have an application for nanotubes," Gower said. "In time, we'll see them in almost everything." ■ AB

Bob**GRAVIER**

Building a successful company one block at a time

One thing Bob Gravier has learned during his career is that engineering teaches discipline and persistence.

Hard work and ingenuity have paid off for Gravier, a civil engineering alumnus, entrepreneur, and inventor. Products developed by his company, Allan Block, have been used for landscaping near high-profile landmarks such as Olympic Field Stadium in Atlanta, the Statue of Liberty, and even Camp David, the presidential retreat in Maryland.

> "My engineering training was invaluable to me when I started this business, and it still is today."

But Gravier's start wasn't fast or easy. Take his college degree, for example. Before graduating in 1980, he spent 11 years in academia, a consequence of changing schools (transferring from Michigan Tech to the University after his freshman year), changing majors (from civil engineering to architecture to landscape architecture and back to civil engineering), and dropping out for two years to focus on a growing landscaping business he and a friend started as teenagers.

The business, Up A Tree, which began as a tree-trimming service for homeowners, had expanded to include snowplowing, landscaping, and construction. "We had a 40-acre nursery in Maple Grove, [Minn.], a fleet of trucks, and five crews in season," Gravier said.

He got married, bought a house, and had a child on the way when he had a falling-out with his business partner and suddenly found himself unemployed.

"Engineers can always get a job," he said, "so I decided to go back to college."

To help pay for tuition and to support his family, he launched another landscaping company. By the time he graduated, he was making more money running the company than he could earn as an entry-level engineer, so he invested his engineering skills in the business.

That company, Allan Block, is now a leading provider of stackable concrete blocks for landscape walls, retaining walls, and fences. Gravier, whose middle name is Allan, designed the blocks after inspecting some walls he'd built with treated timber—the product of choice in the 1970s. After only ten years the walls were falling apart, despite industry claims that they would last for 50.

"I realized I was building with inferior materials, so I sat down at my drawing board and came up with an alternative," he said. "There's an Allen wrench, so I figured, 'Why not an Allan block?'"

His original patent was for a hollow-core block with a raised front lip that creates a locking mechanism and allows the blocks to be "dry stacked," without using fasteners or mortar. The company has since developed and patented other mortarless block systems, which it licenses to its worldwide network of manufacturers.

Allan Block also helped pioneer the use of "geogrid," a flexible synthetic mesh, as an efficient way to reinforce the soil behind the walls.

The reinforced walls offer unprecedented stability.

With a little innovation and a lot of hard work, Bob Gravier turned a small landscaping business into a global company that continues to expand operations in Canada, Asia, Australia, and Europe. His Edina, Minn., office includes an area he calls the "sandbox," where he conducts seminars for contractors and showcases his products.

According to recent seismic research in Japan sponsored by Allan Block, the walls can even withstand earthquakes.

"You can throw a 7.2 on the Richter scale at an Allan Block wall, and nothing happens. The forces go right through," Gravier said.

His block doesn't need to withstand those kinds of forces in his company's headquarters in Edina, Minn., where he has created a parklike indoor environment. Employees work behind cubicle walls made of Allan Block units, and a waterfall trickles into a beautifully landscaped fishpond located near Gravier's corner office.

Reflecting on what it takes to succeed in business, Gravier ticked off a list of essential entrepreneurial traits.

"Introducing a new technology to the engineering and construction market is a real challenge. You need to be very determined, and at the same time you have to be flexible," he said. "There's no recipe. You have to adapt to the challenges the marketplace throws at you. You also need to know how to multitask because in the beginning you're doing everything."

Early on, Gravier was surprised to discover how illogical the marketplace could be. From his perspective, the advantages of switching to Allan Blocks should have been obvious to customers.

"My formula said, 'Allan Blocks are profitable for the manufacturer and the contractor and a great value for the owner. These guys are going to buy millions of Allan Blocks the day after they meet me,'" Gravier said. Instead, it took years of training, marketing, and engineering refinement to convince customers that it would indeed be profitable to use Allan Blocks rather than treated timber and other products.

His University classes taught Gravier only part of what he needed to know. He mastered sales by sitting at the kitchen tables of potential customers three nights a week for 10 years, and he learned construction by "playing in the dirt."

Nevertheless, he's glad he persisted for 11 years and received his degree. His diploma now hangs in his office alongside some of his first patents.

"My engineering training was invaluable to me when I started this business, and it still is today," he said. ■ AB

ALLAN BLOCK

In addition to enhancing many backyards and parks, Allan Block products have been used for landscaping near high-profile landmarks such as Olympic Field Stadium in Atlanta, the Statue of Liberty, and even Camp David, the presidential retreat in Maryland.

Jim**MISHEK**

Prototype of an entrepreneur

The next time you go shopping for electronics, hardware, general merchandise, or even groceries, take a look around the store. Take note of the gadgets, widgets, tools, and containers you see.

If the items were made in Minnesota, chances are they have passed through Jim Mishek's plant on their way to a merchandise display shelf near you.

Mishek, a 1974 University materials science graduate, is president of Vista Technologies, a manufacturer of industrial prototypes. With the aid of state-of-the-art milling machines and other computerized production equipment, Mishek and his 27 employees transform the dreams of designers and inventors into three-dimensional working models.

Last year the company, based in Vadnais Heights, Minn., celebrated its ninth anniversary by doing more than $6 million worth of business.

To describe the company's clientele as varied understates the sheer breadth of human ingenuity required of Mishek and his team. They have produced models of Calphalon cookware, NordicWare Bundt pans and muffin tins, Toro lawn mowers, medical devices from Medtronic and St. Jude Medical, industrial equipment for 3M, a chubby plastic prototype of a squeezable Pillsbury Doughboy syrup container, and a prosthetic jaw ordered by a Duluth surgeon for a cancer patient.

This list doesn't even include what appears to be a man's size-25 shoe produced in special cooperation with the Red Wing Shoe Company for Igor, a young man originally from Ukraine, who stands 7 feet 8 inches in his stocking feet. The shoes were a Christmas gift from Vista Technologies, and Mishek says there wasn't a dry eye in the room when Igor tried them on, turned to his mother, and beamed, "Oh, Ma, this is the best I've ever felt."

Sometimes Mishek and his staff don't recognize the finished product until it appears on the market months after they've created the prototype.

"We get so many orders, we don't know what we're making sometimes," he says. "We don't want to know. For example, we made the casing for the Microsoft Xbox, but we didn't know what it was." A couple of years later Mishek's employees spotted the Xbox for sale, and that's when the mental lightbulbs went on.

> "Don't get wrapped up in theory. Look past [preconceptions]. Don't get tunnel vision."

This cell-phone casing is just one of the many recognizable prototypes created by Vista Technologies. The company has produced three-dimensional models of Calphalon cookware, Toro lawn mowers, medical devices for Medtronic and St. Jude Medical, 3M industrial equipment, Pillsbury syrup containers, and much more.

"We get so many orders, we don't know what we're making sometimes. We don't want to know. For example, we made the casing for the Microsoft Xbox, but we didn't know what it was."

When Jim Mishek founded Vista Technologies with his wife, Lorinda, nine years ago, the company had four employees, one prototyping machine, and zero customers. Now the company has 27 employees, state-of-the-art technology, and 600 customers worldwide that generated more than $6 million worth of business.

In a spotless production room at Vista Technologies, three large rectangular machines unencumbered by human attendants are tethered to nearby computer monitors and positioned over vats of costly resin. Known as StereoLithographic Apparatus [SLA] units, they are building layer by layer the first three-dimensional version of a new housing for an electronic gadget.

The prototype will emerge untouched by human hands, and "that's when my wife takes over," Mishek said.

Vista Technologies is very much a family company. Two of the Misheks' three children work for the company—one as sales manager and the other as operations manager. His wife, Lorinda Mishek, who studied design at the University, is "in charge of the arts and crafts side of the business," he said. She sands, smoothes, and finishes the prototype models, an integral part of the company's work, before the final unveiling.

She's also the reason Jim Mishek attended the University. "I went to Iowa State for my first year of college, but I had a love interest back in Minnesota," he said. "We've been married for 32 years."

Love may have brought him to the University, but it was the quality education that made him stay. "There were only six students in most of my classes [in materials science]. It was very small, very intimate," he said.

Mishek remembers a class in failure analysis taught by Professor William Gerberich of the chemical engineering and materials science department. The course, structured as a series of case studies, required the students to determine the causes of real-life engineering disasters.

"You had to pull everything together. It was a mystery you had to solve," he said. "Everybody failed the first case study, though. A soil pipe [had] broken, and we all missed the most obvious fact. There was no flaw in the pipe. It broke because the load was too big."

The lesson Mishek learned? "Don't get wrapped up in theory. Look past [preconceptions]. Don't get tunnel vision," he said.

To most entrepreneurs, that advice sounds like a prototype for success. ■ JW

Susan**RANI**

Profile in courage

When University alumna Susan Rani founded her engineering consulting firm, she took as her motto the famous declaration by Franklin D. Roosevelt: "The only thing we have to fear is fear itself."

Today, it looks as if Rani doesn't have much to fear anymore.

When she started her business in 1993, very few women engineers were in decision-making positions, she said.

But Rani was ready for the challenge. She had worked for a variety of public and private sector employers, including the U.S. Army Corps of Engineers, the Minnesota Department of Transportation, and Bechtel Power Corporation in San Francisco.

She also has what she believes it takes to be a successful entrepreneur—persistence, patience, and a willingness to take calculated risks.

"It's difficult to take a risk, especially when you don't know what the benefits are," she said. "Yet that's what you need to do to get started."

> "The worst thing you can do is to be afraid to make a decision because you think you'll fail."

Based in St. Paul, Minn., Rani Engineering provides civil, transportation, and water resources engineering services nationwide. Over the years, projects have included everything from levees to light rail.

Landing a design contract for a $5 million flood-control levee and walking trail in Lake County, Ind., was an early coup for the company. Having to commute back and forth and get approvals from local agencies was new and challenging then, but it also "gave us a lot of confidence," Rani said.

One of her firm's most high-profile projects was the new Hiawatha Light Rail Transit Line, which links downtown Minneapolis, the airport, and the Mall of America. For this Metropolitan Council project, Rani designed parking lots, drainage systems, and utility at rail stations.

More recently, the firm—now up to eight full-time employees and three part-timers—has conducted considerable business with wastewater treatment plants.

Originally from Korea, Rani came to the United States when she was 12 years old. With a mother who taught high school algebra and a father who was a civil and mechanical engineer, she, too, gravitated toward math and science.

Like her father, she chose to attend the University of Minnesota. She majored in engineering, she said, "because it was a well-respected profession, and you could earn a decent living after college."

In addition to her bachelor's degree in civil engineering, which she completed in 1982, she also received an MBA from the Carlson School of Management in 1994. Both degrees give her credibility, but trial by fire has been the best teacher of all, she said.

One of Rani Engineering's most high-profile projects was the Hiawatha Light Rail Transit Line, which links downtown Minneapolis, the airport, and the Mall of America. For this Metropolitan Council project, Rani designed parking lots, drainage systems, and utility at rail stations.

This past fall Susan Rani took time in a park near her St. Paul office to reflect on her 13 years as an entrepreneur. She believes that persistence, patience, and risk taking are the traits needed to be a successful entrepreneur.

For example, negotiating skills simply had to be learned the hard way. Some of the offers her company has received have been insulting, and the perception that women and minorities will do the same work for less money troubles her.

"One engineering company, which shall remain nameless, said we should be able to do a project for *x* [dollars], and I said, 'For *x* [dollars], you can keep it,'" Rani said. Taking that risk paid off. The company called back and asked her to do the project—and to name her price.

She now spends less time on project details, devoting most of her efforts to communicating with clients, reviewing and submitting proposals, finding subcontractors, and working on staff development.

"We've been in business 13 years, and it takes that long to establish a track record," Rani says. "Trust is very high on the list of selection criteria" for contract work.

Rani appreciates the strong support she's received from her family while she's endured the ups and downs of starting a company. Her husband, Robert, is an electrical engineer who graduated from the University in 1982, and they have two daughters ages 14 and 6.

"I spend less time with them than if I were an employee and not an active business owner," she says, "but they understand Mom's work is important and do their part to help the family."

Every day in the CEO's chair brings with it the responsibility for making many decisions. The good news, according to Rani, is that it gets easier with practice.

"As you make more and more decisions—good, bad, or indifferent—your quality of decisions improves," she said. "The worst thing you can do is to be afraid to make a decision because you think you'll fail."

FDR couldn't have said it better himself. ■ AB

John**WEINEL**

Aiming to save lives through innovation

One winter morning in 1992, a young man drowned when his snowmobile plunged through the ice on a lake near John Weinel's suburban Minneapolis home. Weinel remembers his first reaction: "There should be an automatic flotation device for snowmobiles."

> "As soon as the Nebulus saves its first life, I'm going to call the parents [of the 1992 accident victim]. I want to tell them that their son did not die in vain."

Weinel, a 1984 mechanical engineering graduate, was working for his family's sign fabrication business at the time. He was in no position to act on his idea, so he filed the thought away for "someday" in the future. But as the years went by, Weinel, the father of six daughters, couldn't forget the tragedy that had struck that young man and his family.

Weinel learned that an estimated 50 people throughout the United States and Canada are killed in similar accidents each year and that the number of fatalities is increasing as the popularity of off-road ATVs rises. Finally, in summer 1999, Weinel decided that "someday" had arrived.

Resolved to translate his concept of snowmobile safety into reality, Weinel knew just where to turn for help. He contacted mechanical engineering professor Virgil Marple, who taught ME 4054, a hands-on class in which engineering students show what they've learned.

Officially known as Design Projects, "it's the last class that seniors in mechanical engineering take [before graduation]," Weinel explained. Students in teams apply their skills to real-life problems posed by carefully chosen "industry advisors."

By the end of the summer, the five students developing Weinel's idea had created a working prototype of an inflatable flotation device that would—in theory, at least—deploy from the seat of a snowmobile in an emergency.

The students took their specially rigged snowmobile to Medicine Lake in Hennepin County for a test run. One daring volunteer agreed to "water skip" the craft into the distinctly unfrozen late-August waters. Two other students waited nearby in a rescue boat. After a suspense-filled moment, the system worked.

"It floated the snowmobile beneath the water and all three strapping students onto the surface," Weinel said.

The combination of Weinel's entrepreneurial flair and the students' enthusiastic research provided a textbook example of the way academic/industrial partnerships should work. The Nebulus Emergency Flotation Device, as the students named it, is now being marketed as standard equipment for law enforcement agencies and fire departments as far away as Alaska.

"My goal is to get a Nebulus device in the trunk of every state patrol car," Weinel said.

The ripcord version of the Nebulus has been in

JTW ASSOCIATES LLC

The Nebulus device weighs only 17 pounds and inflates in less than 30 seconds after its ripcord is pulled. It can keep three people afloat above the water line and support a submerged ATV or snowmobile just beneath the water's surface. The device is now used by a variety of law enforcement and rescue organizations as a safety tool on the snowmobiles and ATVs they ride when patrolling lakes and rivers.

John Weinel's company, JTW Associates, worked with more than a dozen teams of mechanical engineering students over the last six years to develop the Nebulus Emergency Flotation Device.

This winter the company plans to field-test a new model of the Nebulus. Built into the seat of a snowmobile or ATV, this version will inflate automatically if the vehicle breaks through the ice.

production for a year and a half. The target user for this model is a "first responder," like a state patrol officer who is first on the scene of an accident but whose rescue efforts may be hampered by lack of technology.

"Typically the first responder is an officer on his belly lying on the ice with an outstretched stick, waiting for the rescue crew to arrive.... Now first responders can commandeer any snowmobile on the scene, attach the [Nebulus] device, and drive out across the ice to [the rescue]," Weinel said.

Another version of the Nebulus can be used by ultralight aircraft during an emergency landing over water.

Still in development is the automatic version, which Weinel hopes will become a standard safety feature in snowmobiles just as air bags are in automobiles. Also being tested is a model for use in avalanche rescues.

University students have been involved in every phase of the Nebulus' development. Weinel estimates that since 1999 at least a dozen other student teams from ME 4054 have worked on various aspects of the device. After graduation, a few of those individuals have been hired to work for Weinel's company, JTW Associates, in Lakeville, Minn. Others have forged relationships with the company as outside consultants.

Weinel said he has benefited greatly from his collaboration with the University.

"I owe everything to the University," he said. "I'm a true Gopher."

That's not the only interaction with his alma mater that interests him, however. To put it plainly, Weinel wants to be an inspiration.

"I was a terrible, terrible engineering student," he confessed. He hopes that his example of perseverance will motivate "all those guys sitting in the back row of class with nobody to tell them to keep trying."

Weinel has another goal as well. "As soon as the Nebulus saves its first life, I'm going to call the parents [of the 1992 accident victim]," he said. "I want to tell them that their son did not die in vain." ■ JW

WRITTEN BY **RHONDA ZURN**

PHOTOS BY **JONATHAN CHAPMAN**

FORCES OF

LAST YEAR'S HEADLINES STUNNED US with their litany of natural disasters:

Tsunami in Indian Ocean kills more than 200,000 people in 11 countries

Hurricane Katrina kills more than 1,000 and displaces more than a million

Hurricane Rita destroys more than 35,000 homes and kills up to 100

Devastating earthquake in Pakistan kills more than 79,000 and injures 75,000

The scope of these disasters shocked even the scientists and engineers most familiar with nature's destructive powers. For many researchers at the University of Minnesota, the events also fortified their resolve to find better ways to manage disasters, improve infrastructures, and save lives.

At the Institute of Technology's St. Anthony Falls Laboratory, University researchers conduct experiments to learn more about our environment and human impact on it.

"While we humans have learned how to change our environment, it's obvious we haven't been very successful in fully controlling it," said Chris Paola, director of the University's National Center for Earth-surface Dynamics (NCED).

At St. Anthony Falls Laboratory, graduate student Michal Tal studies the effect of riverbank vegetation on stream flow, sedimentation, and channel formation. Here she uses a laboratory channel containing alfalfa and a stream of water infused with environmentally safe red dye. Researchers at NCED use experimental data to create accurate models of rivers and to better understand the role that vegetation plays in stream dynamics.

University scientists and engineers are finding ways to better understand, predict, and manage nature's dynamic powers

NaTuRe

Paola's research has focused on the Mississippi River and changes in the earth's surface in relation to natural deposits of sediment. Management of sediment along the river, intended to improve shipping navigation, has left the coastal area more vulnerable to hurricane damage.

"New Orleans is right on the edge of the water," Paola said. "If we would've allowed sediment to form more deltas, this low-lying land may have helped absorb some of the force of Hurricane Katrina."

Better evacuation planning also could have lessened the death toll from Katrina, said Shashi Shekhar, director of the Institute of Technology's Army High Performance Computing Research Center. With support from the Army Research Laboratory and the Minnesota Department of Transportation, Shekhar and other researchers are developing more efficient evacuation route plans.

According to Shekhar, the problems in New Orleans were exacerbated by several factors: insufficient planning and resources for responding to levee breaches, for evacuating people needing assistance, and for getting information to decision makers. Miles-long traffic jams on Texas freeways during the Hurricane Rita evacuation also exposed the limitations of the transportation network and the inadequate evacuation route planning.

"I do not want to be a 'Monday-morning quarterback.' However, it would have been useful if decision makers had fully funded and completed planning for catastrophic events, such as the levee breach in New Orleans, even if the probabilities were small that they would occur," Shekhar said.

He is a strong advocate of using new technologies to upgrade disaster preparedness.

"Our research here at the University shows that cities can improve existing emergency plans by using computerized tools such as evacuation route planning software," Shekhar said. "In addition, computerized software tools allow cities to examine the interaction among emergency plans of neighboring cities. This is especially critical in large metropolitan areas with multiple cities and townships."

Better forecasting will improve preparedness, and well-managed evacuations can save lives, but the scale of a disaster is determined in part by other factors, said Justin Revenaugh, a professor of geology and geophysics.

People live in seismically active zones and in locations prone to other types of natural disasters because these areas are often naturally beautiful and agriculturally fertile as well, he said.

"These are not bad places to build, provided you build smart," he added. "It's all about building style and quality and population density—primary factors in earthquake fatalities."

Arturo Schultz, an associate professor of civil engineering, has done extensive research on unreinforced masonry walls (no steel reinforcement within the mortar joints or grouted internal cavities). Such construction, common in Pakistan, India, and other parts of the world, has very little resistance to earthquake forces, according to Schultz.

"Upon reaching their load capacity, improperly designed, unreinforced masonry buildings are prone to collapse, making this form of construction extremely hazardous," he said.

Schultz has witnessed firsthand the damage that strong earthquakes can inflict on other types of building structures in countries around the world. He was in Turkey following the 1999 earthquakes and in Mexico City after the 1986 earthquake. On both occasions he saw evidence of structural failure.

In his capacity as chair of the Masonry Society's

Investigating Disasters Program, Schultz has organized and coordinated teams of masonry experts who investigated the effects of earthquakes and tornadoes on masonry construction.

"These observations have allowed us to identify many commonalities in the patterns of damage and failure to masonry structures during earthquakes and sustained high-velocity winds," Schultz said.

The structural engineering technology used to build stronger buildings in the U.S., Japan, New Zealand, Canada, Western Europe, and other industrialized regions would save lives if used in developing countries, but the cost is often prohibitive.

"That kind of structural engineering technology becomes a luxury that many developing countries cannot afford [because they have so many other needs]," Schultz said. "I think the United Nations, World Bank, U.S. government, European Union, and others should establish an international program to develop seismic-design solutions for developing nations—for example, economical solutions that can be implemented by individuals who do not have engineering and architectural design expertise, such as homeowners and small builders."

For one Institute of Technology alumnus, the impact of natural disasters on developing countries hit close to home.

"I was in Sri Lanka in December 2004 when the tsunami hit," said Suresh Hettiarachchi, a 1998 civil engineering graduate. Originally from Sri Lanka, he now works as a water resources engineer in the Minneapolis office of HDR Engineering, Inc.

"I was not staying in the hardest-hit area, but I soon heard about the devastation," he said. "It was unbelievable that in 15 minutes the tsunami killed more than 30,000 people in Sri Lanka and destroyed two-thirds of the country's coast. It really showed me the power of this tsunami and how nature can change things in an instant."

To investigate the formation of river deltas, NCED researchers at St. Anthony Falls Laboratory introduce a mix of sediment and water at a single infeed point in one corner of this experimental basin. Then they take various measurements and study the sediment stratification.

MAST LABORATORY

Researchers at the University's Multi-Axial Subassemblage Testing (MAST) facility conduct large-scale structural testing and analysis, including model-based simulations, of the integrity of structures subjected to earthquakes and other extreme forces. MAST can accommodate test structures up to 25 feet high and 20 feet wide.

Hettiarachchi delayed his departure from Sri Lanka for three weeks in order to help with the relief and rebuilding efforts. He returned briefly to Minnesota to prepare for a longer trip, a 10-week leave of absence from his job to volunteer with the United States Agency for International Development. During that time he worked with the group to reconstruct water systems, roads, and other critical systems. In December 2005 he returned again to Sri Lanka to check on the progress and to find more ways to help.

"What really surprised me in the tsunami was the resiliency of the people to try again," he said. "I was also impressed with the overall level of planning to do things better and consider the environmental impact of their actions."

Hettiarachchi said the experience changed his life and confirmed his career path.

"I always considered myself an 'accidental engineer' because I never really planned to become an engineer," Hettiarachchi said. "My experience in the tsunami relief and rebuilding efforts made me feel better about being an engineer because I was able to clearly see that my skills were of real value to the people as they put their lives and their country back together again." ■

FOR MORE INFORMATION see www.nced.umn.edu, www.safl.umn.edu, and www.ahpcrc.org

A BETTER WORLD

CONTINUED FROM PAGE 13

Although the Doi Santi project seems to have hit a financial roadblock, Gasperino and Makarov are confident the group will find a way around it. They are, after all, engineers.

Over the last several months, members of the University chapter have been working the phones, soliciting donations from area businesses and professional engineers. Callers also inform potential donors that Engineers Without Borders is working to help communities right here at home, too.

ENGINEERS WITHOUT BORDERS

Boarding facilities will allow the children to get an education while maintaining close ties to their families and culture.

"We've got this great project started with the Indian Health Service (IHS) in Bemidji, [Minn.] It's an important project that a lot of people can get involved with," Gasperino said.

Residents of the Grand Portage Reservation, located at the northeastern tip of Minnesota's Arrowhead Region, get their drinking water from Lake Superior. Because the reservation is located near several major point sources of pollution along the lake, individual homes are equipped with UV filtration units to ensure that people have potable water. Unfortunately, something is causing the units to malfunction, and the IHS has asked the student engineers to research the problem and come up with a diagnostics protocol. In addition, they will investigate the possibility of using an alternative filtration system.

"This is an important project for Engineers Without Borders because water quality is something that no engineer [will question]," Gasperino said. "Water quality is the basis of a stable civilization. And the project's local, so a lot of people can be working on the ground, really making a difference."

To Gasperino, making a living and making a difference are one and the same—and engineering a better world begins right here, right now. ■

FOR MORE INFORMATION see www.tc.umn.edu/~ewb

> **"If we can help provide an education for the people living in those villages, we can change their circumstances for the better."**
>
> VLADIMIR MAKAROV

ENGINEERS WITHOUT BORDERS

Several chapters of Engineers Without Borders–USA are collaborating with local residents to design and build new dormitories for the children of Doi Santi and neighboring villages. University of Minnesota students are working on erosion control and drainage measures for the project.

3M Foundation funds new initiative

Grant supports efforts to increase number and diversity of future engineers

THE INSTITUTE OF TECHNOLOGY has received a grant from the 3M Foundation to fund a new effort to increase the number and diversity of engineering students. The $93,000 grant, which is renewable for up to three additional years, has a special focus on retaining women and members of underrepresented populations.

The 3M Foundation Retention Initiative provides financial support for new components of existing programs offered by the Institute of Technology Program for Women, Academic Programs for Excellence in Engineering and Science (APEXES), and the Institute of Technology Center for Educational Programs.

The new components include:

- a 10-week summer bridge program for 20 incoming Institute of Technology freshmen, starting in summer 2006;
- a one-week career exploration program for high school girls being piloted in summer 2006 in which the students will learn about four research areas: chemistry, computer science/robotics, earth-surface dynamics, and nanotechnology;
- a new elective course for Institute of Technology freshmen introducing them to the field of engineering, offered in spring semester 2006; and
- involvement in Project Lead the Way, an innovative engineering curriculum for high school and middle school students that currently is being taught in 42 states.

"Women and people of color have been underrepresented in the fields of engineering and physical sciences throughout our country's history," said Roberta Humphreys, Institute of Technology associate dean for academic affairs. "As our country faces enormous challenges in these areas in the future, we must foster the development of the best and brightest from our entire population. By offering more opportunities earlier in students' education, we can help them overcome barriers and achieve success."

3M Foundation officials agree. "We've seen the news about the overall decrease in engineering graduates in our country, and we think we can do something about that problem," said Barbara Kaufmann, manager of education giving at 3M Foundation. "The first step is to draw more students into the field in the early years and then make sure they're successful. We think the programs funded by this grant help to do just that." ■

GREG HENDRICKS

Civil engineering graduate student Jennifer Bean (far left) demonstrates a shake table for three members of Minneapolis Roosevelt High School's High Tech Girls' Society during their visit to the civil engineering structures laboratory. A new grant from the 3M Foundation will fund new program components aimed at attracting more students to science and engineering.

GIVING TO IT

The Institute of Technology (IT) plays a central role in helping the University prepare for a time of unparalleled scientific and technological change. IT faculty and students are conducting cutting-edge research and forging alliances with business and industry to improve our quality of life.

The future requires a substantial investment of intellectual and financial resources. Only with private support can we meet the ongoing challenge of inventing tomorrow.

For more information on areas of specific need or instructions on how to give, visit the IT Web site at **www.it.umn.edu** and click on the "Make a Gift to IT" link in the Spotlight section.

Boston Scientific gives $500,000 for biomedical engineering fellowships

THE UNIVERSITY OF MINNESOTA has received a gift of $500,000 from Boston Scientific Corporation to fund the creation of the Boston Scientific Corporation Biomedical Engineering Fellowship Fund. The fund will help support new full-time biomedical engineering graduate students during their first semester.

"This gift from Boston Scientific is a critical first step in our goal to continue to attract top biomedical engineering graduate students to the University of Minnesota," said Bob Tranquillo, head of the Department of Biomedical Engineering. "Graduate students are a vital part of the engine that drives our research. By offering fellowship support up front, we can attract students who will continue the University's legacy of breakthrough research in the medical device industry and help chart the frontiers of biomedical engineering."

"Boston Scientific is committed to aiding the development of tomorrow's scientists, engineers, and mathematicians," said Fred Colen, Boston Scientific's executive vice president and chief technology officer. "These same students might someday develop medical technologies that could help save or improve the lives of patients around the globe."

The contribution from Boston Scientific, which will be spread over five years, is a lead gift in a campaign to create an endowment designed to ultimately support the entire class of first-year biomedical engineering graduate students each fall. About a third of the contribution will be used immediately for graduate fellowships, while the remainder will be placed in an endowment to earn interest and fund fellowships over time. The goal over five years is to raise at least $2 million for fellowships. These funds will be matched by the University to generate an estimated $200,000 per year to support 20 graduate students.

BIOMEDICAL ENGINEERING DEPARTMENT

"Biomedical engineering plays a pivotal role in our goal to build stronger ties among biology, medicine, and engineering at the University, especially in the area of medical devices," said Steven Crouch, Institute of Technology dean. "This gift from Boston Scientific is not only important to the biomedical engineering department but also to the future of the entire Institute of Technology."

Grant encourages girls to study math

THE MINNEAPOLIS-BASED Center for Energy and the Environment (CEE) recently issued an initial grant of $6,500 to the Institute of Technology Center for Educational Programs (ITCEP) targeted at training teachers and encouraging girls to achieve in math.

The grant, the first-ever award issued by the nonprofit CEE, helped establish the Girls Excel in Math (GEM) pilot program. During its first year, GEM aims to strengthen the math teaching skills of five teachers and provide challenging math programming for about 50 girls in grades 4 through 7 in five public school districts (Anoka-Hennepin, Centennial, Rosemount-Apple Valley-Eagan, Roseville, and Le Center).

Students and teachers are currently attending workshops designed for girls ages 10 to 12. In this year's program, students are investigating mathematical patterns and their relationship to nature. They also will participate in the ITCEP Family Fun Fair in March.

"Young girls are consistently underrepresented in accelerated math programs," said Sheldon Strom, CEE executive director. "We hope this initial grant will become the first phase of a long-term partnership with ITCEP to help train teachers as they work to change the perception of math education and science careers among girls and young women."

ITCEP is seeking additional follow-up funding for the GEM program. Over the last three years ITCEP has been working with various metro school districts to strengthen upper elementary and middle school teachers' knowledge of fundamental mathematical ideas and their connections to the Minnesota K-12 Academic Standards. To that end, ITCEP developed a professional development program designed specifically for teachers.

DEVELOPMENT TEAM

IT's experienced professional development officers can help you determine your best options for supporting the college. They can give you information about IT programs with funding needs that match your interests as well as information about ways of giving that best fit your financial situation.

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Succeeding generations

Freshman engineering student extends family's IT connection to four generations

DANIEL SCHOBER WAS EIGHT YEARS OLD when his family was featured in the fall 1995 issue of *Inventing Tomorrow*. The story, "All in the IT Family," outlined the close connections that more than 10 members of Daniel's family have to the Institute of Technology—ties that spanned three generations.

Today Daniel is 18, a University freshman planning to major in biomedical engineering. His enrollment extends that connection through four consecutive generations.

But believe it or not, his decision to follow in the footsteps of his mother, father, uncles, aunts, grandfather, grandmother, great-uncles, and great-great-uncle wasn't a foregone conclusion.

"Daniel is a talented athlete as well as a gifted student, and he seriously considered a school where he'd have a better chance of playing baseball," said his mother, Chris, a mechanical engineering alumna.

"I was torn because he loves sports, and I wanted to see him continue to play," she said. "But I know well that the education he will receive here will be second to none."

According to Chris, she and her husband, Steve (an electrical engineering graduate), didn't pressure Daniel to attend the University. At one point they even put money down at another school.

"We tried to be supportive, even though we both had our own opinions," Chris said. "But I didn't pull out the article about our family or anything. I didn't want him to feel like he had to attend the University of Minnesota to carry on a family legacy."

Daniel, who was captain of the football, hockey, and baseball teams at Saint Anthony Village High School in St. Anthony, Minn., said his parents left the final decision to him.

"My parents and I talked about the options, but they didn't try to persuade me," he said. "They knew that I wanted to play sports, and they knew that I want a great education. In the end, when it comes down to athletics versus education, education wins every time in my family."

Education trumped athletics during the past 70 years of Schober family history, but Daniel has not given up on athletics at the University.

"I've joined the snowboarding club, and I'm going to play club sports," he said. "The opportunities here are endless, and I know I made the right decision."

And after Daniel decided to attend the University and major in engineering, his parents showed him the articles and photos documenting their family's Institute of Technology pedigree.

"It was cool," Daniel said. "I knew about some of the people who graduated from IT but not all of them. It's great to be part of family tradition." ■

STEVE LINDERS

"The opportunities here are endless, and I know I made the right decision."

RHONDA ZURN

Last fall Daniel Schober (far left) became the first member of the fourth generation of his family to enroll in the Institute of Technology. More than 10 of Daniel's relatives have ties to the college, including (from left to right) his parents, Chris Schober (ME '80, MME '83), and Steve Schober (EE '78); grandmother Dorothy Leonard (who studied metallurgy); aunt Martha Matern (ME '83) and uncle Mark Matern (ME '83).

ITAS named Alumni Society of the Year

THE INSTITUTE OF TECHNOLOGY ALUMNI SOCIETY (ITAS) was recently named Society of the Year by the University of Minnesota Alumni Association. Last year, ITAS members continued a thriving mentor program and raised $25,000 for scholarships at the annual Science & Technology Banquet. ITAS also participated in the dean search and hosted the ITAS Day at The Works technology museum, which drew about 250 adults and children. ITAS currently has about 6,500 members. Visit www.it.umn.edu/alumni/itas for more information about ITAS or ways to get involved in the organization.

Career center changes name, expands services

CAREER CENTER FOR SCIENCE AND ENGINEERING is the new name of the career services office for Institute of Technology students and alumni. The center will now also serve students and alumni of the College of Biological Sciences. "Merging career services for the two colleges was a logical step because many of the employers who work with us hire people from both colleges," said Mark Sorenson-Wagner, the center's director. "This merger makes the University more efficient, which means we'll be able to help more students and graduates find good jobs." For more information, call the Career Center at 612-624-4090.

ALUMNI NOTES

John Berger (ME '84, MBA '93) and **David Emmons** (ME '84) recently won the first-ever Minnesota Cup, a statewide contest launched in 2005 that seeks out and supports Minnesota's most innovative business ideas. They won the top award for their invention, Arcswitch, a new low-cost optical switch and attenuator for rerouting information carried on fiber-optic networks. They will receive $25,000 in seed capital, Wells Fargo Advisory Board services, and business support services.

Harry S. Brenner (Aero '45), president of Almay Consultants in Los Angeles, has been honored with the 2005 Fred F. Weingruber Award from ASTM International, one of the world's largest standards-development organizations. The award is the highest ASTM award in leadership and sustained service in the field of fasteners. Brenner founded Almay Research and Testing Corporation to test and research fasteners for the aerospace, nuclear, automotive, construction, and electronics industries. He founded Almay Consultants in 2003.

Jonathan DeRocher (ChemE '05) is one of only 35 people nationwide who received the Gates Cambridge Scholarship to study at the University of Cambridge, England. DeRocher is the first University of Minnesota graduate to receive the scholarship funded by the Bill and Melinda Gates Foundation. While at Cambridge, DeRocher is studying materials called block copolymers, used to make nanoporous thin films. Such materials have the potential to filter viruses out of water and could ultimately replace chemical treatment of water.

Robert W. Gore (ChemE Ph.D. '63) has recently received the Perkin Medal from the Society of Chemical Industry, one of the industry's highest honors. Gore is best known for his invention of Gore-Tex, the world's first breathable waterproof fabric. In addition to clothing, Gore-Tex is used today in numerous commercial applications, including artificial arteries, dental floss, specialty guitar strings, and pipe seals.

Jack A. Salmela (Civil '80) is the author of a new fiction book entitled *The Messiah Medallions*. The book is a mystery set in the year 2020 in which a female graduate student in astrophysics discovers her connections to the Persian Magi. The book's foreword includes a tribute to the late Karlis Kaufmanis, the University professor of astronomy whose Star of Bethlehem lecture was a holiday tradition for generations of Minnesotans. Salmela credits Kaufmanis for inspiring him to research and write the book.

Kevin R. Wald (Aero '85) recently received the Southwest Minnesota Entrepreneurial Business of the Year Award presented by Gov. Tim Pawlenty. The award recognized Wald's outstanding accomplishments as president of SpecSys, Inc., an engineering and manufacturing firm with facilities in Granite Falls and Montevideo, Minn. Wald founded the company in 1997. It now employs nearly 150 employees and generates more than $25 million in annual revenue.

IT ALUMNI SOCIETY

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Crash impact: Driven to save lives

Legendary U professor paved way for today's traffic safety research

THE LETTER FROM Athelstan Spilhaus suggested somewhat wryly that perhaps Professor James J. Ryan's crusade for auto safety should begin a bit closer to home. Spilhaus, dean of the Institute of Technology at the time, even offered a practical solution.

"I am sending you a copy of the description of an anthropomorphic test dummy put out by a firm of which a friend of mine is director of research," Spilhaus wrote to Ryan on December 30, 1952. "It occurs to me that you might wish, in the course of your automobile crash experiments, to destroy a dummy before proceeding to living destruction tests."

Although "Crash" Ryan was behind the wheel of test cars that slammed into concrete barricades behind the University's mechanical engineering building, no doubt his dean was the one left with a headache. The mechanical engineering professor earned his nickname by putting his middle-aged body on the line in the interest of auto safety. He conducted dozens of hands-on crash tests that made him a campus legend during the 1950s.

FILE PHOTO

In experiments conducted indoors, sleds were driven into a barrier with Ryan—restrained by a seat belt, of course—at the wheel. In another test, an empty vehicle was dropped from a crane to the ground to simulate a crash speed of 40 miles per hour.

"Cars are a deadly weapon now, and everyone should know as much as possible about them, especially what happens during crashes," Ryan told the *Minnesota Daily* in October 1952.

Ryan eventually abdicated the role of test subject in favor of human-size dummies and remote-controlled "crash cars," but his dedication to the cause of auto safety never faltered. His research led to improvements in shock-absorbing hydraulic bumpers, recessed dashboards, collapsible steering columns, and safety seat belts—and generated public support for establishing minimum safety standards for cars.

Ryan retired from the University in 1963—the year he obtained a patent for the first automatic retractable safety seat belt. Just three years later, Congress passed legislation authorizing the federal government to set and regulate standards for motor vehicles and highways. Experts today estimate that the safety belt has saved more than 195,000 lives from 1975 to 2004.

"I don't think we can say enough about his contributions to the safety of the vehicles we drive every day," said Max Donath, mechanical engineering professor and director of the University's Intelligent Transportation Systems (ITS) Institute. "He created

FILE PHOTO

SAFETY FIRST

"Crash" Ryan's retractable safety belt wasn't his only notable invention. In 1960 he received a patent for a "black box" flight recorder, a mechanical unit that recorded data from several sensors as impressions on metal film. Descendants of his invention are required equipment on all commercial and military aircraft. Ryan, who died in 1973, was a member of the mechanical engineering faculty from 1931–63.

JONATHAN CHAPMAN

TEST DRIVE
Hands-on research isn't what it used to be. James Ryan (far left), in the dual role of researcher and test subject, buckled up in preparation for one of his famous crash tests. (Left) A researcher takes the HumanFIRST laboratory's immersive, virtual-reality simulator for a test drive. The simulator operates with realistic force feedback on the steering and power-assist feel for the braking.

a lasting legacy of what University of Minnesota research has contributed nationally."

Despite the remarkable success of these safety measures, motor vehicle crashes are still a leading cause of unintentional injury-related death in the U.S. According to the National Highway Traffic Safety Administration, 43,005 people died in crashes in 2002. For people ages 3 to 33, crashes are the leading cause of death.

The University continues to be a leader in transportation safety research. ITS, part of the Center for Transportation Studies (CTS), recently received a five-year, $16 million grant from the U.S. Department of Transportation to conduct a wide array of transportation research focused on using technology to enhance safety and mobility. The grant will fund efforts to improve understanding of traffic behavior through improved sensing, Global Positioning System devices that improve feedback to drivers, and measures designed to predict and avoid rear-end crashes.

In Ryan's day, auto safety efforts focused primarily on the vehicle, but transportation data shows that driver error is the direct cause of most crashes and resulting fatalities.

Donath said current research focuses on human-centered technologies that enhance driving ability and reduce driver error caused by distractions, fatigue, and difficult driving situations.

At CTS, affiliated faculty from 25 departments in seven colleges study such issues as driver behavior, assistive technology, vehicle design, public policy, transportation system design, and problems unique to rural and urban areas.

Thanks to modern technology, researchers can study the interaction between people and today's complex transportation systems—without risking life and limb. The centerpiece of the HumanFIRST (Human Factors Interdisciplinary Research in Simulation and Transportation) laboratory is a state-of-the-art multimedia driving simulator used by engineers, computer scientists, and cognitive psychologists to study driver performance.

> **"I don't think we can say enough about his contributions to the safety of the vehicles we drive every day."**
>
> PROFESSOR MAX DONATH

Motor vehicles may be safer than they were in "Crash" Ryan's day, but research shows that in the hands of distracted, inexperienced, or impaired drivers, they are still deadly weapons.

To determine what happens during a crash, the intrepid Ryan put himself in the driver's seat and his personal safety on the line. CTS researchers have at their disposal a range of technology he could never have imagined, but Ryan's legacy—the zeal for saving lives—remains the driving force behind transportation studies at the University. ■ CAROLYN WAVRIN

FOR MORE INFORMATION see www.its.umn.edu

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Tuesday, April 11, 2006 • 5:30-8:30 p.m.
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Senior vice president and director, IBM Research

DR. PAUL M. HORN oversees the world's largest and most prolific research organization dedicated to information technology, with 3,000 researchers at eight labs worldwide. Under Horn's leadership, IBM Research has produced an unmatched string of technological breakthroughs, including the chess-playing supercomputer Deep Blue and the world's first copper chip. A physicist by training, Horn has also led IBM Research into a distinctly cross-disciplinary "grand challenge" with Blue Gene—a $100 million project dedicated to exploring the frontiers of supercomputing, including the use of computation to advance our understanding of important biological processes.

Registration begins in February. All proceeds from the banquet are designated for Institute of Technology student scholarships. For more information call 612-626-1802, email itas@it.umn.edu, or visit www.it.umn.edu/banquet.

OTHER UPCOMING EVENTS

ITAS Day at The Works: ChemFest
Saturday, February 25, 2006

IT Day at the Capitol
Wednesday, March 8, 2006

IT Commencement
Friday, May 5, 2006

UMAA Annual Celebration
Tuesday, May 23, 2006
U.S. Supreme Court Justice
Sandra Day O'Connor, keynote speaker

Visit www.it.umn.edu/alumni for more information on these and other events.